ANNUAL REPORT

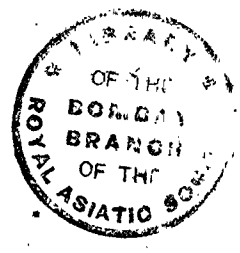
OF THE

DEPARTMENT OF AGRICULTURE,

BOMBAY PRESIDENCY,

FOR THE YEAR

1913-1914.



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No. A.—10838 of 1914.

From

G. F. KEATINGE, Esq., C.I.E., I.C.S.,
Director of Agriculture, Bombay,
Poona;

To

The CHIEF SECRETARY to GOVERNMENT,
Revenue Department,
Bombay.

Poona, 1st December 1914.

Sir,

I have the honour to submit the annual report of the Agricultural Department for the year 1913-14. The appendices submitted by the various agricultural officers give a detailed account of the work done during the year, and I propose to deal less with the work of the year under report, during half of which I was absent on leave, than to give a general statement of the progress of the Department during the past seven years since I was first connected with it. We have now arrived at a somewhat definite stage of development, and it may be of interest to try to estimate exactly where we stand, and to take a review of past progress and lines of probable future development.

CHAPTER I.

Administrative.

2. In the year 1905-06 the budget of this Department amounted to only Rs. 1,48,000.

Since then the budget grants have advanced as follows:—

	Rs.
1906-07	3,59,000
1907-08	6,02,500
1908-09	5,47,000
1909-10	7,10,000
1910-11	6,49,000
1911-12	7,35,200
1912-13	7,84,000
1913-14	8,85,000

During the year 1913-14 the actual expenditure of the Department was Rs. 7,78,861 which was distributed under the following heads:—

Capital Expenditure.

	Rs.
(1) Agricultural College Buildings	53,630

Recurring Expenditure.

(2) Salary	2,56,309
(3) Travelling Allowance	74,838
(4) Construction and repairs	25,720
(5) Cultivation charges	1,25,522
(6) Chemicals and Apparatus	5,760
(7) Implements and Machinery	31,231
(8) Miscellaneous	57,797
(9) Cattle food	19,443
(10) Contingent charges	54,603
(11) Purchase of lands	23,913

	Rs
(12) Special Hydraulic and Agricultural experiments ...	21,780
(13) Importation, cultivation and distribution of cotton and groundnut seed	2,806
(14) Purchase of foreign periodicals and subscription to local Vernacular Agricultural Journals	2,472
(15) Demonstrations and Shows	9,295
(16) Vernacular Agricultural Schools	13,742
	7,78,861

As against this the Departmental receipts credited to Government during the year amounted to Rs. 1,06,300.

In addition to this the Director of Agriculture has at his disposal a personal advance of Rs. 40,000 to enable him to finance the *quasi*-commercial operations which, in the absence of private enterprise, we are forced to undertake to supply to cultivators with the implements, seed, manures, etc., which we recommend and which they want to buy. It is of course on the staff, their accommodation, travelling allowance and contingencies that the great bulk of the expenditure goes.

3. Eight years ago the Director of Agriculture, most of whose time was then devoted to his other duties in connection with Settlement, Land Records and Registration work, had serving under him only one Deputy Director who was assisted by a scanty staff, most of whom drew a low rate of pay. The staff now consists of—

DIRECTOR.

Agricultural College and Research Institute.	*District.*
1 Principal, Agricultural College and Agricultural Chemist.	3 Deputy Directors of Agriculture.
1 Economic Botanist and Professor of Botany.	1 Agricultural Engineer.
1 Professor of Agriculture.	1 Extra Deputy Director of Agriculture.
5 Assistant Professors.	4 Divisional Inspectors of Agriculture.
18 Agricultural Graduates.	46 Agricultural Graduates.
16 Non-graduate fieldmen and inferior staff.	42 Non-graduate fieldmen and inferior staff.

4. The progress achieved must depend mainly on the efficiency of our graduate staff, and it is obvious that with the rapid development which has taken place the majority of this staff are very junior. Some of them have developed well and are doing good work, and some of the junior members are distinctly promising. On the whole, the men who have had special duties assigned to them have done better than those whose duties have been of a more general nature; and those stationed in or near Poona have had more opportunity to keep in touch with developments and to broaden their general outlook and to fit themselves for useful work. The tendency of many who have been stationed in outlying parts is to stagnate, and to show little capacity to adapt their technical knowledge to the practical work which lies in front of them. This is a tendency which we have to fight against, and we are making efforts to do so. The man whom it is most difficult to find is the man who can see defects in existing agricultural practice and point out directions in which practical improvement is indicated, who can handle labour and put through work. Our organization has extended till we have now 20 Agricultural Stations and 19 plots and sub-stations scattered all over the Presidency; while for demonstration work, which is supervised by the four Divisional Inspectors we now have a graduate fieldman for almost every district, and last year we were able to hold 10 Agricultural Shows of some size and 111 formal demonstrations, apart from the informal propaganda which occupies a large part of the time of our district staff.

CHAPTER II.

SEED.

5. Our primary efforts at agricultural improvement were directed to the introduction of superior varieties of many crops from abroad, to trials of many indigenous varieties collected in different parts of India, and to the improvement of local varieties by selection and hybridisation. A great deal of this kind of work has been done during the past ten years and has been reported from year to year. The general result of this work has been to show that the crops already grown by cultivators are admirably suited to the localities in which they are grown and that, speaking generally, there is no great justification for building high hopes of rapid success by the introduction of foreign seed. In numerous cases where a large series of varieties of such crops as jowári, bájri, cotton, potatoes, oil-seeds, tobacco and pulses, collected from different parts of India and from abroad have been grown side by side for a number of years it has been found that the local variety gives the best profits. This might, perhaps, be expected in a country like India, where for centuries past agriculture has so generally monopolised the practical endeavours of the population, and where there is such obvious evidence of the care with which the various crops and varieties of crops have been selected with reference to local conditions. Even in cases where a new variety of crop is found to be physically well-suited to a locality where it has not been grown before it is not uncommon to find that it does not suit the taste of the people, that the market is not sufficiently sensitive to appreciate its advantages or that it is unsuited to the rural organisation of a tract in which on physical grounds it appears to deserve a considerable success. We have, of course, not nearly exhausted the possibilities even of varietal trials, but from the large number of negative results that we have obtained we have now been able to eliminate the greater part of the experiments which we have been trying for some years past, and it may be of interest to note the principal successes that we have obtained in this direction.

6. *Groundnuts.*—This is practically the only crop in which the introduction of foreign seed has from the first given unmistakable success. Of a large number of foreign varieties which we have tried, four have obtained an outstanding success, and have not only supplanted the indigenous variety as an irrigated crop in most tracts, but have spread largely to areas with no irrigation facilities. The success obtained may be gathered from the following figures :—

	Acres.
In 1903 the area under groundnut was ...	57,000
In 1913 do. do. ...	181,000

This crop has brought good profits to the cultivators in the Sátára and Sholápur Districts, where it has become most popular, and is gradually spreading in other parts of the Deccan, as well as in Southern Marátha Country and the Konkan. Not only is it a good money-making crop in itself, but it is an excellent rotation crop, and year by year its beneficial effect on the soil is seen in the excellence of the succeeding crop. In many localities the chief difficulty which prevents its rapid spread is the damage done to it by wild pigs, and but for this it would certainly have made far more rapid strides.

7. *Cotton.*—It was proved that in Sind, with perennial irrigation, good crops of Egyptian metaffifi cotton could be grown, and for a time a considerable area was sown with this cotton. The chief difficulties for its successful introduction were that the very poor system of cultivation which is common in Sind would not suffice for Egyptian cotton, and there were difficulties in marketing it. Its cultivation was brought to an end by the uncertainty of the perennial water-supply. These difficulties will have to be overcome before Egyptian cotton becomes a commercial crop in Sind, and they will be difficult to overcome; but when perennial irrigation extends in Sind, I have little doubt that in days to come Egyptian cotton will be profitably grown there, and that our experimental work will then produce its result. Meantime it has been found more promising to push American cotton in Sind. Various good stapled American cottons will grow in Sind with seasonal irrigation and with the same

kind of cultivation that is given to the Sindhi cotton. This season a crop of 1,000 bales is expected in Lower Sind and a special agency exists for marketing it. Whether this cotton is to be grown in Sind extensively or not depends on the price that can be got for it, and in the present state of the cotton market, this year's prices will give us little information; but there is no doubt that good stapled American cotton will grow well in Sind, and some of the larger Zamindárs are keen on it and are cultivating it well.

8. The only other locality in which a foreign cotton recently imported is doing well is the south of the Dhárwár District, where Cambodia does very well in most years. This is a tract which grows Dhárwár-American cotton, and it is as a rival to Dhárwár-American cotton that we are pushing Cambodia. The great advantage of Cambodia over Dhárwár-American cotton is that it has a ginning percentage of 38 as opposed to the ginning percentage of Dhárwár-American cotton which is 28. This means that an amount of seed cotton which will give 100 lbs. of lint in the case of Dhárwár-American cotton will give 130 lbs. in the case of Cambodia. In four years out of the five that we have tried them side by side, Cambodia yielded better than Dhárwár-American in point of seed cotton, and by 1912-13 it had obtained considerable popularity with cultivators and several thousand acres were sown with it. In that year, however, its yield was very poor as a result of continuous rain immediately after sowing, a condition which suited the Dhárwár-American cotton crop, and as a result the area under it fell considerably in the past year. The indications are that in the great majority of years it is more profitable in this tract than Dhárwár-American cotton, and many good cultivators are keen on it. It is, therefore, probable that it will find a permanent place in the crops of the locality, and that the demand for seed will increase considerably. As this occurs we shall take steps to meet the increased demand.

9. The introduction of Broach cotton into the western part of the Dhárwár cotton tract which gets both the early and the late rains has been a considerable success. The advantage of this cotton lies in the fact that, whereas its yield of seed cotton per acre is at least equal to the local Kumpta cotton and the quality of the lint at least as good, the ginning percentage is 33 as against 27 in the case of Kumpta. This means an increased production of lint to the extent of 24 per cent. In order that the full market value of this superior ginning percentage may be obtained, we have found it necessary to grade carefully all the Broach cotton grown in the Dhárwár District, on the basis of ginning percentage, and to hold an annual auction. The area now under Broach cotton in the Dhárwár District has now extended to about 2,500 acres and at the last auction cotton worth over Rs. 1½ lákh was sold bringing to the cultivators a profit of about Rs. 40,000 over and above what they would have obtained by growing Kumpta cotton. The advantage to be obtained by growing this cotton is substantial, and in some villages they now grow it almost to the exclusion of the Kumpta cotton. The difficulties in the way of securing its more rapid extension are as follows:—

(1) It requires a longer growing season and has to be sown earlier. This gives rather more trouble.

(2) It has to take the risk of both the early and the late monsoon, and is liable to damage by the vagaries of the July and August rainfall at a time when the Kumpta cotton is not yet sown. This difficulty was marked in the present season when the continuous rainfall in July and August did considerable damage.

(3) Fresh seed has to be brought from Gujarát every few years, since the high ginning percentage deteriorates after a few years in the Dhárwár District.

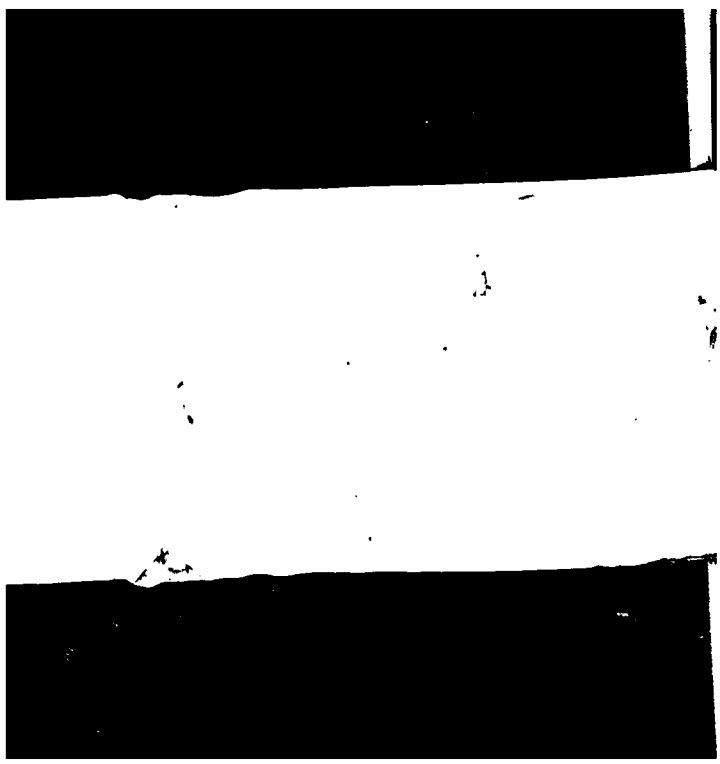
(4) To secure the proper prices we have to grade the cotton and hold an annual auction.

Difficulty No. (1) is not serious, but cannot be ignored in a tract where the cotton-growers cannot be described as generally hard-working.

No. (2) is more serious, though the risk is small as compared with the advantage to be gained in the great majority of years.

ERRATUM SLIP.

Page 5, para. 11, lines 9 and 10, *for* " 305 to 325 " and " 165 to 205 " *read* " 30 S to 32 S " and " 16 S to 20 S ".



No. (3) is not serious and can easily be overcome by organisation.

No. (4) is somewhat crucial, since, though we have been able to undertake this work on a small scale, it is not possible for us to extend it indefinitely. The cotton must be grown within reasonable carting distance of the scene of our auction-sale and this of course limits the area that can be sown. We cannot undertake to grade and sell the cotton of the whole country side, and no one seems disposed to take up this work. It would be a pity to drop this line of development since it ought to bring in several lákhs of rupees in additional profits to the cultivators of this tract; but the difficulties mentioned above are taken together considerable, and unless we can find some way to overcome the marketing difficulty, I fear that we shall have to drop the work.

10. In the improvement of the Kumpta cotton our work has given substantial result. We now have a Kumpta cross cotton which year by year gives a ginning percentage 2 per cent. better than ordinary Kumpta, denoting an advantage of 8 per cent. in the quantity of lint, and we have a selected Kumpta strain which, with continued selection, gives a ginning percentage of 3 to 4 per cent. better than ordinary Kumpta, denoting an advantage of 12 to 16 per cent. in the quantity of lint. That such an advantage may be realised it is necessary that the market should be sensitive; and how little this is the case is exemplified by the following facts. It is found that in certain definite localities in the Dhárwár District, owing to natural advantages, the ginning percentage of the ordinary Kumpta cotton is, year by year, about 2 per cent. better than is the case over the great bulk of the area where this kind of cotton is grown. The buyers of seed cotton are aware that some advantage of this kind exists, and will sometimes offer a rupee or two more per naga (1,344 lbs.) for cotton from those villages; but the real advantage would be represented by an additional value of Rs. 12 per naga. With a market so little sensitive it will be realised that the advantage of a new cotton must be very large and obvious before it is possible to secure for the cultivator the fair price which will make him anxious to adopt it.

11. In lower Gujarát, where the ginning percentage of the cotton is already high, our efforts were directed to improvement in the quality of the lint, and met with considerable success. Of the many improved strains which showed promise we finally selected three, of which two were hybrids and one was a selected cotton, and by 1909 we were putting out these cottons on a fairly big scale. The lint of these cottons was most favourably reported on both in Bombay and in England by the trade which expressed much satisfaction at the improvement effected. Our cotton had a staple of 1 inch and was reported to be good for spinning 305 to 325 when ordinary Surat cotton was good for 165 to 205, and our seed got a good name locally so that the cultivators were often able to get a better price for the produce, and once when we arranged with a Mill-owner to take over the produce of 500 acres at a rate 5 per cent. in excess of the prevailing rate he expressed himself well pleased with his bargain. It was then felt that the time had come when we must be able to guarantee to the cultivators a better price for the cotton grown from our seed if we were to get our seed widely taken up. We therefore approached the trade, and in 1911 a Syndicate was formed in Bombay which undertook to purchase cotton grown from our seed at 5 per cent. over current market rates. This scheme came into operation in 1912 when 1,167 bales of cotton grown from our seed were purchased by the Syndicate at a rate 5 per cent. in excess of current rate, and though the operations were not free from difficulty the Syndicate and the cultivators both expressed themselves as well satisfied. In the following season some 17,000 acres round Surat were sown with our seed and about 6,000 bales of cotton were produced. Early in this buying season, however, difficulties arose, and the Syndicate declared that they were being made to pay excessive prices. The cultivators were certainly very much alive to the possibilities of working the arrangement in their own interest, and three main difficulties were found to exist:—

(*a*) There was no authoritative means of deciding what was the ordinary current local price of seed cotton for the day, and cultivators

were apt to declare that they had been offered such and such prices for their cotton by local buyers, and to claim 5 per cent. extra. The Syndicate questioned the reality of such offers, and it is certainly possible that local dealers did offer a better price on account of the superior quality of the cotton and that the Syndicate was thus asked to pay the increment twice over.

(*b*) The Syndicate were under agreement to buy, but the cultivators were not under agreement to sell. The result was that on any day when prices were low the cultivators brought in no cotton, while on any day when ordinary prices were high the cultivators brought in their cotton in quantities and claimed 5 per cent. over the ordinary rate for the day.

(*c*) The market in that season steadily fell, and all who held up stocks suffered. As a result of these causes the arrangement for marketing this cotton broke down, and the Syndicate closed its operations towards the close of the season. It was afterwards alleged that some of the clean cotton, which arrived in Bombay and purported to be grown from our seed, was no better than ordinary cotton. We did our best to see that no substitution took place and employed a large staff for the purpose, but it was impossible for us to say that no substitution took place between the time when the seed cotton left the field and the bales of clean cotton arrived in Bombay. The Syndicate made a genuine attempt to help us in popularising this new seed, and our thanks are due to them, but the scheme contained inherent difficulties which, in the circumstances of the season, resulted in a breakdown, and made it clear that it is the local buyer of seed cotton rather than the cotton merchant in Bombay who dominates the situation. Since the breakdown of these arrangements the cultivators have been left to make their own arrangement for disposing of the produce of our seed. They are glad to get our seed and recognise the superiority of the cottons which it grows and can often get a somewhat better price for it; but unless they can be certain of getting a better price the majority will not take much trouble to obtain it, nor will they pay for it a price materially higher than they pay for ordinary seed at the gins.

12. From the above facts it will be realised that in the present condition of the cultivators and of the cotton market an improved cotton must have the following characteristics in order that it may obtain rapid success:—

(1) The improvement must be in quantity rather than in quality.

(2) The improvement in quantity must be considerable and obvious.

(3) The cultivation must involve no additional labour or risk to the cultivator.

13. An improved cotton which has these characteristics has been found for Khándesh and the neighbouring districts in Roseum (N. R.) cotton. It yields more heavily than the ordinary Khándesh mixture, it has an advantage in ginning percentage of 3 per cent., denoting a further 9 per cent. increase of lint, it has a good colour which attracts buyers, and is a hardy and early maturing variety. The growing of this cotton is worth at least Rs. 6 per acre in additional profits to the cultivators in an area which grows some million and a half acres of cotton, and the cultivators have rapidly realised the advantage. We have far larger demands for this seed than we can supply, though we charge more than double the price of ordinary cotton seed, and to meet this demand we have opened a large departmental seed farm and have 19 seed-growers who grow our pure seed on an area of 732 acres. One lákh lbs. of this seed was sold during the past year, and we shall steadily increase the number of our seed-growers. In addition to our departmental efforts, some individuals and organisations are taking steps to produce this seed in a pure state for themselves. The success of this seed appears to be certain.

Other crops.

14. I have dealt with the case of cotton at some length since that crop has occupied a large part of our efforts, but the other crops have also received

considerable attention. Pure line breeding is being carried on in the case of such crops as wheat and jowári, and shows promise; good varieties of wheat, rice and sugarcane have been introduced into tracts where they were not grown before and are likely to spread; berseem and pulses have been introduced into Sind; and there is a considerable demand for seed of many varieties at all our stations, which we do our best to supply; but having regard to the excellence and variety of the ordinary food crops of the country, to the circumstances of the cultivators, the organisation of the markets and the facts mentioned in the next chapter, I am personally of opinion that at our present stage of development it will be very difficult to effect an improvement in the seed supply of the common food-crops which will be sufficiently marked to obtain general recognition. Good cultivators do appreciate the advantage of good seed, but in many tracts the average cultivation is so bad that good seed gets little chance of showing its value. To a farmer who keeps no accounts the nature of the season and the state of the market represent the determining factors of his profit or loss.

CHAPTER III.

Cultivation.

15. Perhaps the most striking fact on our farms has been the steady improvement of the crops on them after some years of good cultivation. When we took over the land it was in all cases full of weeds and in a state of very poor tilth and condition. The general superiority and evenness of our crops over the average of the surrounding tracts is now very marked and is mainly due to good, clean cultivation. The foul state of the black soils in the Deccan has been too often the subject of comment to need much mention now, but I may give a case which I saw this year in the Ahmednagar District. Bájri had been sown in the field, but had in August been completely choked out by hariáli and kunda. I asked the cultivator what he intended to do, and he said that he proposed to harrow down the bájri and sow rabi jowári in September. I pointed out that the rabi jowári was likely to share the same fate as the bájri, and he admitted this, but said that he had no means to clean the land. This occurred in a remarkably favourable season; and there are hundreds of thousands of acres of good land in the same condition. It will therefore be realised that our most vigorous efforts must be in the direction of better cultivation. Of course, if the cultivators really chose to turn out and work with a pick-axe in their fields in the off season they could clean the land in the course of a generation. Some few energetic men do so, and some of the richer land-owners pay labourers to do such work; but the progress made is very slow, and the pace is not likely to increase.

16. To meet this case we introduced iron ploughs which do excellent work in cleaning the land. Even some years ago we numbered the iron ploughs that had been introduced by the ten thousand, and now the number introduced has increased so fast that it cannot be estimated how many are in use; but the number is very large. At the College farm alone implements worth Rs. 20,000 are sold annually, and a factory for iron ploughs established by Mr. Kirloskar in the Sátára District turns out great numbers and sometimes sells as many as 500 in a month. Many Agricultural Associations stock iron ploughs for sale and hire, and some co-operative societies keep them for the use of their members. At our farms and at our implement depôts we keep ploughs for sale and hire and we arrange for their demonstration and repair when necessary. The most popular kinds introduced are the Gallows plough for deep garden cultivation, the C. $T._2$ plough for somewhat less deep cultivation and the Sabul plough for comparatively shallow cultivation. In Sind the Egyptian plough has come into very wide use, and in the Konkan light iron ploughs are slowly spreading. The beneficial result of these iron ploughs must in the aggregate be very large.

17. Amongst other implements the disc and several other forms of harrow and hoe are doing good work and are on the verge of gaining popularity, an iron scoop for levelling land is selling fairly well and the Olpád thresher has been favourably received by the wheat-growers in the south of the Presidency.

A small American seed drill is doing well for jowári, but so far we have not found a suitable drill for sowing cotton which will obviate the large losses which now result in many tracts from gaps in the sowing. Some years ago at an agricultural show in Belgaum I asked an intelligent cultivator what he liked best in the show and he pointed to a very fine pair of our bullocks which were working a gallows plough really well. I entirely agree with him, and think that our most pressing problem for the near future is better implements and better teams.

18. For deep cultivation we introduced three large geared French ploughs which did good work to a depth of 15 inches, but were very slow, and last year we introduced a steam plough which has done excellent work. A full report on this subject has been made, and it will suffice to say, that for Rs. 21 an acre it ploughed 770 acres of foul land to a depth of 16 inches turning up and destroying the dense mat of deep-rooted weeds. In spite of the inexperience of the staff and difficulties with both the quantity and quality of the water available for the boilers, it paid its working expenses, its charges for depreciation and 6 per cent. interest on capital outlay. A second steam plough has been ordered and will arrive shortly, and a small motor plough will this year be tried for lands where a steam plough could not work.

19. Hitherto we have had little experience of cultivation in the East Deccan where the rainfall is very light, but at Ahmednagar we have tried some experiments in dry-farming. Our experience there has been that in a year of moderate rainfall typical dry-farming methods are of distinct advantage in conserving moisture, but that in heavy black soil even the most careful cultivation will avail nothing in a famine year. In the year 1912-13 when a badly distributed rainfall of 10½ inches fell at Ahmednagar our crops failed as badly as those of the neighbouring cultivators. It had been proposed to open a station in the East Deccan to study further the question of dry-farming methods, but I think that the first thing to do is to classify the soils of the East Deccan and study their physical properties, and the question of starting a station to try dry-farming methods must be deferred till we have made this study and know what kind of soil we wish to select. This matter is certainly of much importance to us, and I have reported on the matter and asked for a man to study soil physics.

20. It is very difficult to say that at present there is any general marked tendency on the part of the cultivators in the direction of better cultivation. Such a general tendency is difficult to detect; but the introduction of the iron plough cannot fail to be of great benefit, and I believe that our work of propoganda is bearing fruit. I am assured that in Khándesh, at any rate, the high prices of cotton in recent years have provided the cultivators both with the incentive and with the means to cultivate better than of old, and that they are now far more careful in their methods than they used to be.

CHAPTER IV.

Manure.

21. The advantage of manure, like the advantage of using good seed, depends largely upon the state of cultivation of the land, and it will be realised that there is little advantage to be gained from applying manure to land which is in the condition mentioned in the last chapter. On clean land, however, our experience has been that in tracts and seasons of good rainfall the soil responds very readily to a moderate dressing of farm-yard manure, and that the cultivators know the most profitable quantity to apply and the right time to apply it. In tracts where ploughing is hardly practised the manure does not become well mixed with the soil, nor does the wooden plough mix manure with the soil nearly as well as the iron plough which inverts the soil, and this defective mixing involves some loss to the cultivator.

22. In tracts of light rainfall the cultivator of dry-crops sets little store by manure, saying that it "burns the crop." This too has been borne out by our experience, and there is no doubt that in such tracts the dressing of manure

must be very light and must be judiciously applied, otherwise it may do harm. In these semi-arid tracts cultivation is certainly of more importance than manure, and the practice of the East Deccan farmer is supported by the experience of the American farmer of the dry tracts.

23. In regions of good rainfall and in irrigated tracts it is common now-a-days to hear much about the scarcity of manure, and as irrigation facilities extend this difficulty will increase. But it must be remembered that as compared with most other countries India is well off for farm-yard manure, and it is the cheapness of farm-yard manure in India which makes the introduction of artificials unnecessary in some localities and difficult in others. Still, given the necessary moisture and adequate cultivation, there is no doubt that the land can well do with more manure than it gets at present and to provide for this state of affairs we have taken the following action :—

(*a*) We demonstrate the proper method of storing farm-yard manure in pits instead of leaving it in heaps exposed to the sun and rain, and we explain to cultivators the benefits of conserving the urine of cattle by running it into the manure pits or by placing a layer of fine earth in the cattle byres.

(*b*) We are actively preaching the practice of green manuring. For garden crops, wheat and rice, san hemp is an excellent green manure and the people of some tracts are taking it up keenly. As regards rice this practice is of limited application since san hemp will not grow in a field where the moisture is excessive; but in such fields "*dhainsha*" can be substituted which will stand far more moisture, though it gives less bulk.

(*c*) We have introduced oil-cakes as top-dressing for garden crops in localities where they were unknown, and arrange for their supply in some cases where it is necessary to do so.

(*d*) We have experimented with artificials, but have found that they will not pay for dry-crops. The only cases in which we are confidently recommending the use of artificials is in the case of sugarcane and irrigated potatoes. For sugarcane we recommend a top-dressing of sulphate of ammonia, and for potatoes a complete manure. The use of sulphate of ammonia for sugarcane is slowly spreading and about 100 tons a year are now used in this Presidency, a large part of which is brought by the people of one village in the Sátára District who are keen on it. The potato manure was only recommended during the past year, but is likely to become popular. It is probable that as our experience extends we shall be able to recommend artificials for other garden crops. In this connection it may be mentioned that an old student of the Agricultural College has taken up the business of dealing in artificial manures and undertakes considerable propoganda amongst the cultivators on his own account.

(*e*) At Surat and Dhárwár, both tracts of good rainfall, we have shown the extraordinarily good results that can be obtained by the application of night-soil and the remarkable length of time that its effect will last. On suitable soil in these regions it is hardly too much to say that if a man will thoroughly clean his land and apply a heavy dressing of night-soil once in a generation he can continue, year by year, to grow fine crops of cotton and jowári with no more effort than is involved in the simple operations of harrowing, sowing and inter-culturing. I am afraid that it is too much to expect that in the near future the cultivators will generally adopt the practice of conserving this substance as is invariably done in China and Japan; but many Municipalities now prepare "poudrette", and its use is becoming common in places where no one would have looked at it a few years ago. We must try to encourage its manufacture by Municipalities which now waste it. In some cases they are deterred from manufacturing it by a doubt as to whether they will be able to sell it, and to meet this difficulty I have recently offered to guarantee a Municipality against loss up to a small amount if they will undertake to make a start in this direction.

24. It is of course on the Deccan Canals where the cultivators apply the most enormous dressings of farm-yard manure to sugarcane that the manure difficulty is most felt. Much of the manure so applied is wasted as a result of defective cultivation and over-irrigation, and much of it can be replaced by economical substitutes. We have recently published full information on the subject.

CHAPTER V.

Agricultural Education.

25. The detailed account of the Agricultural College which is given in Appendix A makes it unnecessary for me to say much about this institution. Its buildings are now practically complete and its farm well organised. I think that the facilities for agricultural study that exist there compare very well with those offered by efficient institutions in other countries, and I believe that it has established itself on a sound foundation. We should be glad to obtain more of the sons of large landowners throughout the Presidency, but considering the difficulty in attracting students which has been experienced in other parts of India we must regard ourselves as having done remarkably well in this respect. The fact that it turns out some 20 agricultural graduates every year and some 15 students who have been put through a practical course of one year in order that they may fit themselves to manage their own properties cannot fail in time to make its influence felt on the agriculture of the Presidency. There is a considerable demand by the public for trained agriculturists to manage estates, and we could find jobs for far more men than we have available to take them. Within the Department also there is work to be done which cannot be undertaken till we can provide trained staff for the purpose.

26. The agricultural school at Loni continues to flourish and to improve. The boys there receive a practical two years' course in agriculture, while their general education is continued with an agricultural bias. An oil-engine has lately been added which pumps water, chaffs kadbi and crushes grain. It is managed entirely by the head master and the boys. A carpenter's and blacksmith's shop is being added. The gain to the boys from this course is more than the practical instruction which they receive. Their outlook is greatly broadened and they are able to appreciate the possibilities of agricultural progress and the directions in which it may be secured. Many of them return to their own lands, others obtain jobs at the rate of pay far in excess of what they could have otherwise obtained. Each boy who goes to the school costs Government about Rs. 300, but in the majority of cases the gain to each boy cannot be less than Rs. 300 a year, apart from the general gain to the community.

27. The agricultural school in Sind has now been opened for two years and is doing well. The Kánarese school at Devihosur has just been opened, and that at Godhra in Gujarát is under construction and will, I hope, be opened next year. I think that there is a great future for such schools, and they are certainly liked by the people. The people of Chopda in Khándesh have collected money for the establishment of an agricultural school, and the proposal to establish there a school of less elaborate nature has been sanctioned by Government. A gentleman in the Konkan is providing funds for the establishment of an agricultural school in the Thána District. These schools will be opened when we can provide suitable head masters; but at present the supply of agricultural graduates does not meet the demand. Last but not least I may mention that at Alibág, in the Kolába District, Sirdar P. K. Biwalkar has established an agricultural school at his own cost and under his own supervision, which is doing good work. It is not quite on the same lines as our school at Loni, but aims at giving to smaller boys an education of a more general nature, agriculture being the primary subject of instruction. An agricultural graduate is employed as Head Master and a good start has been made. It should prove of great benefit to the locality.

CHAPTER VI.

Agricultural Engineering.

28. The work of the Agricultural Engineer has been developed with energy and enthusiasm. Much has already been achieved, and there is great promise of future success. I have always anticipated that this line of work would give rapid results since it is a matter about which the cultivators have been profoundly ignorant. Two main lines of work have been developed, viz., water lifting and cane crushing by machinery and well boring. Water lifting by oil, gas and steam engines is rapidly becoming popular in parts of the Presidency, and there are now a large number of pumping plants at work. Not only do these raise water from wells at a less cost than could be done by bullocks but their use has the effect of setting free from an operation which rapidly wears them out a large number of bullocks and making them available for field work. Further on river banks the use of such engines makes available for irrigation water which could not otherwise have been used. The number of such pumping plants in use on the Mulla-Mutha and Bhima Rivers is large, and the addition to the irrigated area is already considerable. Some of these pumping plants are of considerable size, the largest that I know of being one erected on the banks of the Sábarmati River, about 15 miles from Ahmedabad, which is worked by a crude oil-engine and is capable of irrigating several hundred acres of sugarcane. The Agricultural Engineer and his staff are engaged up to the limit of their capacity in designing and erecting suitable pumping plants to meet varying conditions, and in advising, and assisting owners in their management. They undertake the repair of engines which have gone out of order and train owners to manage them properly. The public are making very full use of the advantages offered to them.

29. There are now at least 10 power-driven cane-crushers at work in the Presidency, which mark a very desirable form of progress. It is really deplorable to see the losses suffered by cane-growers on the Deccan Canals due to the primitive methods by which the excellent cane which they grow is handled. Bullocks are worn out by exhausting labour and a large part of the juice is lost through defective crushing, while for want of means to get the crushing done rapidly much of the cane has to stand over till it has deteriorated, and 12 months' cane is frequently carried over till the end of the rains and occupies the ground for a full 18 months. The advantage of power-crushers is so obvious that the number is bound to increase, though at present want of capital, confidence and co-operation makes progress slow.

30. *Boring.*—Until the past year we had confined our attention to the alluvial soils of Gujarát. We have tried several kinds of well boring tools and have found in the Musto borer an excellent implement for working either by hand or with a small engine. We have, by our restricted operations extended over five years, added to the irrigation resources of Gujarát an increase amounting to 900,000 gallons per hour; and most important of all, we have demonstrated the possibility of finding sub-soil water under pressure with fair certainty in large tracts. The matter has been reported in detail during the past year and has been considered by a special committee appointed for the purpose, but it may not be out of place here to state that in definite parts of Ahmedabad and Kaira we can guarantee water under pressure almost with certainty at depth of less than 200 feet, and in other tracts where the strata are less regular and our shallow borings have met with varied success it is almost certain that water can be found at somewhat greater depths. At Nadiád, a typical region of this latter kind, a boring of 600 feet made by the Sanitary Department passed through no less than six water-bearing strata. There can be little doubt of the possibility of turning Upper Gujarát into one large garden, and we have to see that this possibility is gradually realised. In Lower Gujarát where conditions are more difficult we have met with good success in parts of Broach and Surat, and our latest success at Surat added a constant flow of 14,000 gallons per hour from a bore taken only 30 feet below the bottom of an existing draw-well. In the Deccan we have had fair success in locating crevace water by means of Mansfield's automatic water finder, and in tapping it by

means of the Musto borer. Such supplies are not usually large nor are they always under pressure, but the indications are distinctly promising on a small scale. We are now just beginning to prospect for water in the shists, shales, sand-stone and lime-stone formations of the Southern Marátha Country, but the result remains to be seen. In localities where we can find at reasonable depths sufficient good water for domestic and field purposes the gain to the people will be very great; indeed I can hardly believe that any other development will tend so much to the well-being of the countryside.

CHAPTER VII.

Mycology and Entomology.

31. The prevention and cure of fungoid diseases usually involve care and expenditure, and here as in other countries, it is chiefly in connection with the more valuable garden crops that measures of this nature can be introduced. In the case of the valuable grape and supári crops, which suffer severely from fungoid diseases, spraying has been found very beneficial and has been demonstrated for some years past. The more advanced grape growers are now taking kindly to spraying and recognize its advantage and the supári growers are becoming convinced and by patient effort will be induced to see where their advantage lies. In the case of sugarcane *red rot* is caused by defective drainage and spread by the use of affected sets. Work has been done to convince people of the advantage of using disease-free sets, and such sets have been supplied to cultivators in affected tracts, but the primary cause of the disease is more difficult to tackle since defective drainage can only be remedied by a considerable outlay.

32. The steeping of jowári seed in a copper sulphate solution as a preventive for *smut* has given very good results and many persons have taken it up. This disease causes large losses in many parts of the Presidency and it is common to see fields where 20 per cent. of the heads are smutted. This year packets of copper sulphate sufficient to steep the seed for four acres of land were prepared in one anna packets enclosed in a wrapper giving in three languages detailed instructions for use. Many were sold, and the purchasers are well satisfied with the results. The matter will be pushed actively, for it is possible by the expenditure of one anna to save an average loss of Rs. 10 and that too with a minimum of trouble. If the practice of seed steeping could be generally introduced the gain to the cultivators would be far greater than the cost of the Department.

33. In the matter of entomology the most successful practical result has been the clearing from a large area of rice land near Belgaum a local pest of rice hoppers which had devastated the crops for many years past and was extending the area and intensity of its ravages. Extensive operations of sweeping them up in drag nets were conducted over a period of four years by this Department with the support of the local authorities and the Belgaum Agricultural Association and with the assistance of locally raised subscriptions. The results have been consistently successful, and during the past year the hoppers were so few as to be negligible. In other directions practical results have been small. Here and there a swarm of locust hoppers has been stamped out, and the practical possibility of hand-picking caterpillars has been demonstrated; but with small and interlaced holdings the cultivator is seldom willing to take isolated action or to combine with his neighbours for a general campaign of this nature. The protection of stored crops offers a more promising field for activity. Practical methods have been found for protecting stored grain and potatoes against the insects which annually cause such large losses; and we shall endeavour to introduce them.

CHAPTER VIII.

Miscellaneous.

34. Permanent improvements to the land play a prominent part in the agricultural progress of any country, and it is satisfactory to note a considerable

disposition on the part of many well-to-do land owners in this Presidency to lay out money on such. The efforts of this nature that are being made in the direction of well-boring and the erection of pumping plants have already been mentioned, and there can be no doubt that the provision of irrigation water ranks as a prime necessity wherever it is possible. Apart from this the terracing of land and the creation of field embankments is a very profitable and necessary form of improvement which is proceeding at a fair pace in some localities. The damage to crops from scour, the denudation of large areas of land and the loss of plant food in the rain water that runs off the land all point to the necessity for remedial action; indeed there are some tracts where the damage done is so general that such action may be said to be the first real step in the matter of improvement. This question has been studied during the past year and a note on the subject will shortly be issued.

The erection of wire fences to protect fields from the trespass of wild and domestic animals and in particular of wild pigs is another matter which landholders are considering, and in some places extensive wire fences have been put up. The damage done by wild pigs is enormous and wide-spread. This Department has successfully tried poison against them, but this method is effective only in certain conditions and requires to be employed under careful control, so that it is not suitable for general adoption. Rewards are, I understand, offered for killing pigs but few are claimed. In some districts also gun licenses are issued only on condition that the licensees shoots so many pigs in the year. The idea is good in both cases but the results produced are almost negligible. The matter is so serious in many localities, from an agricultural point of view, that I cannot help thinking that the rewards might with advantage be increased to a point which would produce marked results and gun licenses issued freely on the condition of killing pigs. It is not only the actual damage that they do that must be laid to the charge of the pigs, but also the loss of crops that the cultivators refrain from sowing because they know that they will be seriously damaged.

35. There are other important matters of a general nature that have been the subject of detailed consideration during the past year, notably the allotment and effective use of canal water and the provision of fodder for cattle in time of famine. In both cases I have submitted notes to the Committees which considered the matter. The whole question of cattle-breeding and cattle-feeding also is one deserving mention, but I refrain from touching on it here since a cattle survey is now in progress and the matter will be separately reported on before long. I merely mention such general questions because their consideration forms an important part of the work of this Department, apart from the purely technical matters which we handle. I have already endeavoured to deal with these latter and it only remains for me to mention a few lines of work which found no place in previous chapters. The first that I would call attention to is the study of fruit-growing made at the Ganeshkhind Garden, which enables us to give valuable advice on many matters to fruit-growers. A second consists of investigations in the reclamation of salt land and the prevention of salt efflorescence which has been carried on in Sind and in the Deccan, and which led this year to a general survey of canal lands in the Deccan to determine their suitability for perennial irrigation. A third is to be found in the improved process of *gul*-making which we have introduced into many backward tracts. Not only has the furnace been improved so as to effect a large saving of fuel, but the quality of the *gul* has been so improved in some places that people assert that they now get double the price for it that they formerly used to obtain. In the most advanced tracts also progress in this respect is going on. The use of the saccharometer for determining ripeness of cane is now appreciated by progressive cultivators, and saccharometers are selling freely. The annual short course that is held at the Mánjri Farm on the subject of cane-growing and *gul*-making has become popular and is doing good.

CHAPTER IX.

Propaganda.

36. I have already mentioned that we now have a staff of four Divisional Inspectors, sixteen agricultural graduates and eight non-graduate fieldmen whose duty it is to assist and advise cultivators in their charges and to demonstrate and organise improvements. This staff gets in touch with a very large number of cultivators in their own villages, and, in addition, organised or helped at 10 shows and 111 demonstrations, during the past year. Some of the demonstrations on our farms are very largely attended and in the months of September and October last year, no less than 2,250 cultivators came from all over the Deccan to see the College Farm, and special arrangements were made to accommodate them and to show and explain to them all that there was to see. In addition to these demonstrations a trip was organised for a party of selected cultivators to show and explain to them instructive cultivation of an advanced nature in a more progressive tract.

37. Our publications now amount to 66 bulletins and 61 leaflets, of which the following are the latest :—

Bulletins.

(1) Bulletin No. 56.—Present state of the Dairying Industry in Bombay.
(2) Bulletin No. 57.—Improvement of the indigenous Plough of Western India.
(3) Bulletin No. 58.—Prickly-pear experiments.
(4) Bulletin No. 59.—Common Salt and its use as manure in the Konkan Division.
(5) Bulletin No. 61.—Sugarcane—Its cultivation and gul manufacture.
(6) Bulletin No. 62.—The value of castration of Deccan bullocks.
(7) Bulletin No. 63.—Substitutes for ráb.

Bulletins in the Press.

(8) Bulletin No. 60.—Note on Indigenous Sugar Industry and Modern Methods of Sugar Manufacture.
(9) Bulletin No. 64.—Alkali or Kalar Experiments and Completion Report of Daulatpur Reclamation Station in Sind.
(10) Bulletin No. 65.—A list of Diseases of Economic Plants occurring in Bombay Presidency.
(11) Bulletin No. 66.—Indigenous Implements of the Bombay Presidency.
(12) Bulletin No. 67.—An Examination of the Seed Supply of the Sholápur District.

Leaflets (with Vernacular versions).

(1) Leaflet No. 7 of 1913.—Cultivation of Potatoes in Bombay Presidency.
(2) Leaflet No. 1 of 1914.—Hints on Fig Cultivation.
(3) Leaflet No. 2 of 1914.—Bullock Feeding.
(4) Leaflet No. 3 of 1914.—Manure for Potatoes.

Leaflets in the Press.

(5) Leaflet No. 4 of 1914.—The determination of ripeness in cane for gul-making by Brix Saccharometer.
(6) Leaflet No. 5 of 1914.—The Koleroga disease of Betel palm.

These are widely distributed.

In addition to this form of publication the following agricultural journals now exist :—

(*a*) The Maráthi Monthly Journal issued by the Deccan Agricultural Association.

(*b*) The Kánarese Monthly Journal issued by the Dhárwár Agricultural Association.

(*c*) The Gujaráthi Quarterly Journal issued by the Broach Agricultural Association.

The Department gives considerable assistance and support to these periodicals, which are now obtaining a wide circulation. Further the Agricultural College Magazine, published in English, contains much useful agricultural matter and finds a sale outside the circle immediately interested in the College.

38. Six new Agricultural Associations have been registered bringing the number up to 56 and, though few of these undertake sustained or regular operations, a good many of them stock implements, take seed and distribute our literature. The Agricultural Shows held are mainly organised by these Associations usually with the assistance of local officials. Their activities are distinctly beneficial.

39. The connection between the Agricultural and the Co-operative movements is becoming much closer. Not only are there Co-operative Societies organised directly for agricultural improvements, such as Dairy Societies, Cattle Breeding Societies and Seed Societies, but many of the Credit Societies are now proving admirable bases for agricultural propaganda. To mention two cases: the Hulkoti Society has taken up the steeping of jowári seed against smut and has been active in introducing to its members Cambodia Cotton and groundnuts; while the group of Societies round Málegaon stock improved implements for sale and hire, have induced their members to dig pits for the proper conservation of farm-yard manure. These latter Societies have not only grown Roseum (N. R.) Cotton supplied by the Department but have arranged to grow and keep pure their own seed supply. They have further applied for and will shortly engage a man to direct and expand their activities for the improvements of their agricultural methods. Developments of this kind are a most promising sign of the times.

40. I think that we may claim to have established close relations with the cultivators in the regions where we have had most opportunity of working. There are still regions where the existence of the Agricultural Department is hardly known, and there is much work of this kind that remains to be done; but I am satisfied that the progress has been satisfactory in relation to our present capacity, and the general public certainly bears us the greatest good will.

41. I have not attempted in this report to single out for appreciative mention the individual work of any members of the Department and propose this year to limit myself to an expression of deep regret for the retirement and subsequent death of Mr. Yashvantrao Nilkanth Anandkar, Personal Assistant to the Director of Agriculture, who has served Government faithfully and efficiently for thirty years.

I have the honour to be,

Sir,

Your most obedient Servant,

(Signed) G. F. KEATINGE,
Director of Agriculture.

APPENDIX A.

No. 2364 of 1914-15.

Poona Agricultural College :
Poona, 6th August 1914.

From

HAROLD H. MANN, D.Sc., F.I.C.,
Principal, Poona Agricultural College ;

To

THE DIRECTOR OF AGRICULTURE,
Bombay, Poona.

Sir,

I have the honour to submit herewith the Report of the Poona Agricultural College for the year ending 30th June 1914.

College Buildings.

2. The year under report is the sixth since the establishment of the College as a separate institution. It has had the use of the whole of the new buildings during the year, except the hostel, which though expected to be ready in September 1913, and occupied in its unfinished state by students, is not even yet quite completed,—as the sanitary arrangements have been very much delayed.

University Agricultural Course.

3. The University Agricultural Course, to which the main energy of the College is devoted has now been in operation for several years. Though fairly satisfactory, it has been subjected to much criticism during the year—the latest being from Sir Alfred Hopkinson who visited the College on behalf of the Bombay University in November 1913. With regard to this course he writes as follows :—

"It appears to me desirable to consult with the authorities of the College at Poona as to the possibility of reducing the number of University examinations in this subject. The constant pressure of impending examinations may interfere with steady practical work, and in view of this the second examination in Agriculture might perhaps be omitted. The first examination would deal with the general scientific subjects, and the two other years of the course would be devoted to Agriculture and the special Agricultural subjects which will be included in the final examination. Possibly arrangements might be made for recognition of the Science courses in other colleges where Chemistry and Botany are taught, as providing what is required for the first year. In Ahmedabad, for example, there are excellent laboratories for Chemistry and Botany, and a Special Professor of Botany has been appointed, and in the D. J. Sind College a professorship of Biology has been established. A similar question will arise with regard to the new Science Institute at Bombay, when opened.

"At the same time the question of allowing some options in the subjects to be taken at the final examination could be considered, having regard to the character of the practical work in Agriculture which different candidates would be likely to take up after obtaining a degree.

"I also desire to point out the advisability of encouraging Post-Graduate study in the Agricultural College. The foundation of scholarships or fellowships to encourage Post-Graduate study and research in this subject is most desirable. I believe that any benefactions which might be given for the establishment of such scholarships would be likely to lead to results of real value. The development of the Agricultural College as a centre for agricultural research and information, as well as for training students, should be fostered in every possible way."

It is probable that a Committee will be appointed in the near future by the Bombay University to consider in co-operation with the college authorities, how far effect can and ought to be given to Sir Alfred Hopkinson's proposals, and what other modifications should be made in the arrangements.

Short Course.

4. The short course, started five years ago, as an addition to the College work, is intended for farmers' and landowners' sons. For this the sole qualifications are that the student should

know English and have a fairly good general education. The training given is essentially a practical one, and is designed to give the men as good an acquiantance as possible with the best methods of agriculture applicable to our areas. There was at first some doubt as to whether there was a real demand for this course, but this is now entirely dissipated, and the number of the suitable students tends to increase. The actual number of students attending the course has been as follows :—

1909-10	4
1910-11	12
1911-12	13
1912-13	15
1913-14	15
1914-15	22

College Staff.

5. The staff of the college has suffered no permanent losses during the year but, owing to leave and other arrangements, there have been a number of temporary changes. Professor J. B. Knight after continuous and devoted service since 1907 went on two years' leave to America in April 1914. His place as Professor of Agriculture has been taken temporarily by Mr. P. C. Patil, L. Ag., one of the most brilliant graduates of the College until September 1914, while Ráo Sáheb G. K. Kelkar, for long Assistant Professor will act for Professor Knight during the remainder of his leave. It gives me great pleasure to note that the Professor of Botany, Mr. William Burns has been honoured by the Degree of Doctor of Science by the University of Edinburgh for research work during the past year. Dr. Burns was on privilege leave during the college vacation in April and May 1914. The Assistant Professor of Botany (Mr. H. M. Chibber, M.A.) was appointed to act as Professor of Botany in the Gujarát College, Ahmedabad, during the early part of the year under report, and after his return acted for Dr. Burns, in addition to his own duties, during the latter's leave.

The new position of Assistant Professor of Dairying was created during the year, and Mr. E. W. Horne, who has been for some years Manager of the Government Civil Dairy, Kirkee,—now become the Agricultural College Dairy,— has been appointed to the position.

The oldest member of the staff of teachers, Mr. D. D. Sanga, G. B. V. C., Lecturer in Veterinary Science, whose work dates back to a period long before the college was a separate institution, retired during the year. He had given long and devoted service in his subject. His place was taken by Mr. F. Gracias, G.B.V.C., while Mr. B. B. Joshi, G.B.V.C., was appointed as Demonstrator in Veterinary Science. Both of these are experienced teachers of the subject.

Mr. B. S. Patel, B. Ag., Assistant Demonstrator in Agriculture was granted a University Scholarship by the Bombay University, to go to England for the purpose of studying Dairying and Cattle Breeding, and his place was taken by Mr. R. S. Inamdar, B. Ag. At the end of the year an additional post has been created among the demonstrating staff on the college farm, and Mr. K. S. Kulkarni, B. Ag., has been placed in the position.

Students.

6. The number of students this year is slightly higher than in 1913, but the increase has been wholly among the students of the Short Course. The actual figures for the past six years have been as follows :—

	1909.	1910.	1911.	1912.	1913.	July 1914.
First year students	38	36	38	38	43	36
Second year students... ...	26	33	24	27	25	31
Third year students	39	27	28	22	26	27
Short course students ...	4	12	13	15	15	22
Special and Post-graduate students.	1	2	1	2	1	1
Total ...	108	110	104	104	110	117

The students during the last five years included in the above table have come from the following parts of India:—

	1910.	1911.	1912.	1913.	1914.
Bombay Presidency... Deccan ...	32	28	28	28	23
Bombay Presidency... Southern Marátha Country and Konkan.	35	34	25	29	38
Bombay Presidency... Gujarát ...	18	23	25	27	23
Bombay Presidency... Sind	6	4	6	4	8
Eastern Bengal and Assam	8	2	...	...	...
Central Provinces...	...	1	...	1	...
Bengal	2	1	...	...	...
Central India	...	...	3	3	3
Nizám's Dominions	4	2	2	5	7
South India and Ceylon	5	9	14	11	12
Burma	...	...	1	1	...
United Provinces	...	...	...	1	2
Berar	...	...	...	...	1

Arranged according to the castes or classes from which they come, the studen s stand as follows:—

	1909.	1910.	1911.	1912.	1913.	1914.
Bráhmins	68	64	54	45	45	43
Maráthás	4	5	8	4	5	5
Lingáyats	5	6	5	2	5	4
Pátidárs (Gujarát)	4	5	4	3	2	2
Mahomedans	7	7	4	10	10	17
Pársis	1	2	4	9	9	13
Eurasians	...	...	...	1	1	1
Others	19	21	25	30	33	32

7. These students may be divided into three classes:—

(*a*) By far the larger number are qualified to study for, and intend to take, the agricultural degree of the Bombay University. The qualification on which the Bombay University insists, namely, the Previous Examination or its equivalent, is insisted on in the case of practically all students from the Bombay Presidency itself, and no student can, of course, appear for the University Agricultural degree without it.

(*b*) The second class consists of a few students who are not admissible to the University Examination, but who are taking the regular course along with the first class of students. These exceptions arose from the fact that it has been decided by Government to allow scholars to be received from Sind who have only passed the Matriculation Examination, provided that they were to receive the same course, and pass by the same standard as the University demands. Under this ruling, students have been received every year since 1908. At the same time some applications were received from other Governments in India and Ceylon to be allowed to send students and from private persons outside the Presidency for admission to the college, where the applicants were not fully qualified for the University course. Where there was evidence to show that such students could properly follow the course a small number have been admitted as follows:—

	Admitted in 1909.	Admitted in 1910.	Admitted in 1911.	Admitted in 1912.	Admitted in 1913.	Admitted in 1914.
Bengal	...	...	...	...	...	...
Eastern Bengal and Assam ...	2	...	...	...	...	...
Nizám's Dominions	...	...	...	...	...	1
Sind	1	1	1	2	1	2
Bombay Presidency and Native States (Subordinate) ...	...	2	3	...	...	2
Ceylon	...	...	...	5	...	...
Goa	...	2	1	...	...	...
United Provinces	...	...	...	...	1	1
Central India States... ...	...	...	...	...	...	1

(c) In the third place, we have the short course students already referred to. The places from which they come are as follows :—

Deccan	3
Southern Marátha Country	4
Gujarát	3
Nizám's Dominions	5
South India	3
Central India	1
Bombay	...
Sind	2
Berar	1

As has already been stated, this course is not a qualification for Government service in British India, and the large majority of those who take it, do so with the intention of putting their training to advantage in actual farming. We have this year, for the first time, two boys belonging to the Talpurs of Sind, who have joined this class.

8. In addition to these classes, we are being occasionally requested to undertake the training of men for special purposes. For the last two years we have had a young man with us in training for botanical work under the Department of Agriculture, Burma. We have at present a man under training for special botanical work under the Department of Agriculture, Travancore.

University and other Examinations.

9. At the University Agricultural Examinations held in 1914, the number of candidates shown in the following list were presented, with results, as indicated :—

	Sent up.	Passed.	Failed.	Percentage of passes.
First Examination in Agriculture	34	26	8	76·4
Second Examination in Agriculture	20	17	3	85·
Bachelor of Agriculture Examination	23	18	5	78·3

The results are fairly satisfactory.

A special College Examination of the students (referred to above) not entitled to take the University Examination, was held in February and March 1914 with the following results :—

	Presented.	Passed.	Failed.
First Examination in Agriculture	3	2	1
Second Examination in Agriculture	6	6	...
Final Examination for Diploma in Agriculture	3	3	...

9A. The number of students who passed through the regular course at the college, and succeeded in obtaining the University degree or the College Diploma (which is of the same standard and represents precisely the same character of man) is as follows during the past six years :—

	Degree.		College Diploma.		Total.	
	Entered.	Passed.	Entered.	Passed.	Entered.	Passed.
1909	34	26	...	...	34	26
1910	39	36	...	...	39	36
1911	22	20	5	5	27	25
1912	27	22	1	1	28	23
1913	19	14	4	3	23	17
1914	23	18	3	3	26	21

The cause of the apparent falling off in numbers is largely, if not entirely, due to the transition from the old course in Agriculture to the new one which came into force in 1909. There was an accumulation of students who had started the old course and were not able without much extra work to reach the standard of the new one. Thus there were many failures in 1909, and these appeared again in 1910 and swelled the numbers abnormally in that year. Again there was rather a rush into the course in 1906 and 1907 when the demand of the Agricultural Department for men, who were not then available, was very great. Since that time matters have become normal, and the number who appear for the final examination may be taken to be, normally, from twenty-five to thirty. The number who appeared and passed in 1913 was exceptionally low owing to a very severe University first year's examination two years before (in 1911), but the number has become normal again in 1914.

Scholarships.

10. The number of scholarships offered by Government at this college is now fifteen per annum. Candidates must have passed the Previous Examination of the Bombay University or obtain the certificate from the Principal of an Arts College, which the Bombay University now accepts instead of that examination, and are selected by the Director of Agriculture in consultation with the Principal of the College. They are given by preference to the sons of cultivators and are awarded for the three years occupied by the course. The Director of Agriculture is empowered to extend the tenure of the scholarships to four years, and give a limited number to Matriculates, who afterwards will join this college, for study in an Arts College. During the last six years scholarships have been awarded to candidates from the various districts as follows:—

	1909.	1910.	1911.	1912.	1913.	1914.
Deccan	...	2	5	6	2	2
Southern Marátha Country ...	3	3	3	2	3	4
Gujarát	2	3	6	...	2	4
Konkan	1	2	1	...	1	5

11. The students from Sind are on a different basis. They are appointed by the Commissioner in Sind, and are not required to have passed the Previous Examination in every case. We have now at the College, three such scholars from Sind in the first year, one in the second year and none in the third year.

12. Other Governments and the public bodies have utilised the College for the training of scholars. The number so admitted since 1909 has been as follows:—

Date of Entry.

	1909.	1910.	1911.	1912.	1913.	1914.
Government of Eastern Bengal and Assam	2	...	...	...	...	...
Baroda Government... ...	2	...	...	2	...	...
Sángli State	...	1	...	...	1	...
Jamkhindi State	...	...	...	1	1	...
Porbandar State	...	...	1	...	...	...
Kotah State	...	...	1	...	...	...
Vithalgadh State	...	...	1	...	...	...
Jámnagar State	...	...	1	...	...	...
Lingáyat Education Fund ...	3	1	...	...	2	...
Ceylon Government	...	...	...	4	...	...
Bánsda State	...	...	...	1	...	...
Rájpipla State	...	...	...	...	2	...
Junágadh State	...	...	...	...	1	...
Dewas State	...	...	...	...	...	1
Indore State	...	...	...	...	...	1
Mysore	...	...	...	...	...	1

Library.

13. The growth of the College library is very satisfactory. Seven years ago it did not exist. On the separation from the College of Science being completed, a number of books (chiefly old and out of date) on Agriculture, Botany and Veterinary Science were handed over to us and formed a nucleus for the future. A special grant of Rs. 6,000 per annum was made in 1909 for library purposes, and was continued during the two following years. Since that

time the annual grant has been Rs. 2,500. With the funds thus made available and a number of presentations of books, the library has rapidly increased. The number of books in it at the end of the last six years has been as follows:—

1908-09	... 1,182
1909-10	... 2,780
1910-11	... 4,000
1911-12	... 5,040
1912-13	... 5,943
1913-14	... 6,840

It is fairly consulted, not only by college students, but by gentlemen from all parts of the Presidency, and every effort is made to make it increasingly useful to the public.

College Quarters.

14. The college quarters have been completed during the past year with the exception of the sanitary arrangements, which are still in the hands of the Engineers. The quarters seem very satisfactory on the whole, and are much appreciated by the students. The Superintendent, Mr. D. L. Sahasrabuddhe, B. Sc., L. Ag., has managed the hostel excellently and with great tact. The fact that such a large proportion of our students are resident, 96 out of a total of 117 students, makes the college hostel a real centre of college life.

Last year in my report, I referred to the delay in the completion of the sanitary scheme at the college, with special reference to the college hostel. I regret to report that it is not yet completed though at last the matter is vigorously in hand. I feel that it is more by good luck than good management that we have escaped serious results, as the whole place has been built in anticipation of such a sanitary scheme, and the makeshift arrangements we have had to make, though the best under the circumstances, have been by no means satisfactory.

Employment of Graduates.

15. The demand for agricultural graduates is increasing, and there seems now little trouble in placing the good men. As I write I have several applications in hand for men, to fill which I have difficulty in finding satisfactory candidates. Of the past students of the regular three years course who have been employed or arranged for during the year, the direction of activity is as follows :—

Bombay Agricultural Department	7
Bombay Executive Government service	1
Baroda Agricultural Department	2
Other Native State Service	5
Agricultural Departments of other Provinces	2
Private Employer	1
Employed on their own land or in connection with industries, depending on agriculture	1

As I wrote, negotiations are proceeding for placing two or three others in private or semi-private service.

College Dairy.

16. During the year the Government Civil Dairy at Kirkee has been placed under the control of the college and the Manager of the Dairy has become Assistant Professor of Dairying. This has been used for several years as a teaching centre for dairying for the students, but in future it will be available in greater measure than hitherto, as this will b (now recognised as one of its primary functions. It is being modernised, and brought up to date for the purpose.

Veterinary Dispensary.

17. The District Veterinary Dispensary at Bhámburda has beeen carried on as a college Dispensary during the year. Charge of the dispensary was in the hands of Mr. D. D. Sanga G. B. V. C., till August 9th, 1913, when he retired. Since that time Mr. F. Gracias, G. B. V. C., has been in responsible charge, assisted by Mr. B. B. Joshi, G. B. V. C., as Resident Veterinary Officer. During the year there has been a distinct increase in the number of patients. A total of 1,059 animals were treated (as against 846 in the previous year), of which 404 were in-patients and 655 as out-patients. The daily average attendance of in-patients was 15·9, and of out-patients 8·7. Of those treated 510 were agricultural animals. Out of the 1,059 cases, 513 were treated free. Among contagious diseases, there were twenty-three cases of suspected rabies in dogs, of which thirteen proved to be rabid. A large number of cases of foot and mouth disease were treated in connection with an outbreak at Kirkee and at Mánjri. Two cows were treated for rinderpest and extensive inoculation undertaken on surrounding dairy farms. An outbreak of *hæmorrhagic septicæmia* occurred near Mánjri. Four animals were

treated but all died. Preventive inoculation was undertaken in the surrounding farms. Animals were also treated (dogs and a cow) for *piroplasmosis*. All these cases were reported at once to the Superintendent of the Civil Veterinary Department. The Superintendent, Civil Veterinary Department, inspected the dispensary on June 23rd, 1914, and the Deputy Superintendent on July 7th, 1913. The Dispensary has just opened a shoeing forge during the last month of the year under report.

OTHER MATTERS.

18. During the year under report, the college undertook the responsibility for the fourth time of giving the short three weeks' course in agriculture which all the junior members of the Indian and Provincial Civil Service have to take. It was attended by eleven members during the present year, and the teaching was undertaken by Professors Knight and Burns, and myself, while the Director of Agriculture, and the Agricultural Engineer to Government also assisted.

19. The staff have worked well, and are doing a considerable amount of research, and also of demonstration work in addition to their own duties. I may repeat what I said last year that the College tends to become every year more and more of a centre for activity in connection with agricultural improvement and the dissemination of agricultural information. It has hence been visited by a constantly increasing number of landlords and other interested gentlemen on the one hand, and on the other by large crowds of cultivators. For nearly two months in September and October 1913, large parties were brought almost daily to the college farm under arrangements suggested by the Commissioner of the Central Division. Every effort is made to stimulate this public interest, as it is felt that the permanent success of the institution must largely depend on the extent to which it can be maintained.

I have the honour to be,

Sir,

Your most obedient Servant,

HAROLD H. MANN,

Principal.

LIBRARY OF THE BOMBAY BRANCH OF THE ROYAL ASIATIC SOCIETY

APPENDIX B.

ACCOUNT OF THE VERNACULAR AGRICULTURAL SCHOOL, LONI, POONA FOR 1913-1914.

The Vernacular Agricultural School was established as an experiment, the object of which was to give a thoroughly practical agricultural training to boys who belonged to good substantial village families; and whose object in life was to cultivate and manage their own land. With this conception in view it was opened in Poona in June 1910 as a boarding school and with a course of two years for boys by preference between the ages of 14 and 16 who had passed the fourth Maráthi Standard at least. It is placed under the control of the Principal of the Agricultural College, but is quite independent of the College, with an agricultural graduate as head master.

During the first three years of the existence of the school, it was worked in close connection with the Agricultural College. A portion of the College farm was used for the practical training of the boys, and the school was held, with the boarding arrangements, in a hired bungalow at Kirkee. This was always, however, looked upon as temporary arrangement, and buildings had been under erection for some time an a piece of land under much more rural conditions near Loni village about eleven miles from Poona. These buildings have become ready during the present year, and the whole school was transferred to the new site in November 1913, where it has been carried on since.

In laying out the new school an attempt has been made to make it as much like a large cultivator's *wada* as possible, and, hence, to emphasise as much as possible the purely agricultural atmosphere of the place. The area on which the boys work amounts to twenty-nine acres, immediately round the school, contains land suitable for many varieties of cultivation, with and without irrigation, and a small fruit plantation is being laid out. A small oil-engine for pumping has been installed with which the boys will have to become familiar, and in view of the rapidly increasing number of such plants in the tracts from which the boys come, this knowledge is likely to be important.

The boys at present in the school number 41 derived from the Maráthi speaking districts as follows:—

	1st year.	2nd year.
Poona	2	5
Sátára	1	3
Sholápur	1	3
Ahmednagar	1	...
Násik	5	4
East Khándesh	1	...
Ratnágiri	1	...
Thána	...	1
Belgaum	...	1
Kolhápur State	1	...
Sángli State	2	...
Janjira State	1	...
Aundh State	3	...
Jamkhandi State	3	...
Berar	...	1
Other States	1	...

Arranged according to caste, the boys stand as follows:—

	1st year.	2nd year.
Marathas	11	7
Brahmins	12	11

The head master has been, as in the previous year, Mr. K. M. Pawar, B. Ag., and he has put great enthusiasm and energy into the work. Such success as the school has attained is largely due to him. He has been assisted during part of the year by Mr. R. D. Khandekar who was placed at the school for training, with a view to becoming head master of an agricultural school founded and opened by Sirdar P. K. Biwalkar at Alibág in the Kolába District. At the end of the year another graduate Mr. J. G. Naik, B. Ag. who is intended to be head

master of another agricultural school in the Panch Mahâls, has been placed at Loni for training. These have taken to the work with enthusiam also and promise to make very successful head masters there.

The school has been supported by a number of local boards during the four years the school has been in existence and subsidies have been received af follows :—

	1910-11.	1911-12.	1912-13.	1913-14.
	Rs.	Rs. a. p.	Rs.	Rs.
East Khándesh	200	200 0 0	72	...
Poona	225	.....	720	...
Násik	250	250 0 0	216	288
Ratnágiri	250	.....	216	...
Sátára	...	116 2 1	432	504
Sholápur	...	50 0 0	420	504
Ahmednagar	...	100 0 0	...	840
Thána	...	.....	72	144
Bijápur	...	.....	72	...
Kolába	...	.....	72	...
Belgaum	...	.....	...	72

The curriculum which was very much of an experiment at starting, on the whole has proved, with modification in detail, a considerable success. It involves, as was explained a year ago, at least half the working time being spent in farm work, or in gardening, in dairying or in other agricultural operations. The boys do practically all the work in the land allotted to their use, and they have almost entirely produced the food, except the grain and pulse used in the school. The school work, more properly so called, consists of arithmetic, more especially including farm accounts on the one hand, and mensuration applied to agricultural purposes on the other, nature study largely taught practically, writing and reading, geography of India, especially in relation to crops, the principles of agriculture, and two new subjects (1) village life, including sanitation, hygiene, and secondary occupations suitable for villages; and (2) what we call 'citizenship', which includes questions of how to obtain money by takávi, by co-operative credit, *etc.*, and in addition, the system of local and village government in this part of India.

The number of applications for admission to the school has been largely in excess of the number which we can receive, but they are subjected to a rigorous selection, and admission is only granted to those who belong to the classes which we want to have, namely, those families who are themselves cultivators, or who are small land-owners where the boys are intended to devote this life to work in connection with land. This rigorous selection results in considerable variation in the number admitted. There is always, moreover, a considerable leakage at first—as the course is a hard and practical one, and unless a boy is ready to work on the land at what some consider menial occupation, he does not want to stop. It is, in my opinion, of course essential to maintain this tone if it is to serve the purpose for which it is intended.

The school has been visited frequently by gentlemen, by officers of the agricultural department, and by many of the parents and friends of the boys.

At the end of the school year in April 1914, the boys were examined by Messrs. G. B. Patwardhan of the Ganesh Khind gardens and G. K. Ranade of the Agricultural College, and as a result twenty-two certificates were granted to boys who had completed their two years' training. The examiners made remarks as follows :—

"*1st year.*—The students on the whole have done very well in all subjects especially in practical agriculture. The general standard of teaching is up to the mark and the books prescribed appear to us to be suitable. We have however to note that the book on sanitation is very antiquated. Recently in High School classes one or two books which give good, simple, and practical knowledge regarding first aid and general human hygiene have been adopted. We suggest that these should rather be taught in place of the sanitary primer. The book entitled 'पाऊस आणि झाड' is a very good book for agriculturists as it deals with practically all scientific subjects connected with atmosphere and trees. But as a text book for general reading it is not quite suitable being written in a scientific tone. Even good students could not relate with ease the purport of what they read from this book. A simpler one may therefore be substituted.

2nd year.—In this class also the teaching and the general preparation of the students have been found to be staisfactory. The students exhibited special aptitude in handling and managing farm implements. In Mathematics, with the exception of a few students who fared very badly, the rest have done creditably well. With regard to the book 'वातावरण' set for general reading, we have to repeat the same remark as is passed regarding पाऊस आणि झाड read in the 1st year class."

Forty-five boys have now completed the course and been granted certificates. Most of these are farming on their own or other land. We are keeping as far as possible in touch with them, and it is hoped that they will become centres of influence in the future.

The accounts of the school are shown in the following statement:—

Receipts.	Rs.	a.	p.	Expenses.	Rs.	a.	p.
1. Balance from 1912-13...	2,251	2	1	1. Establishment ...	1,820	0	0
2. Poona Treasury (Government grant).	7,608	0	0	2. Boarding charges ...	3,102	2	9
				3. Purchase of live stock ...	182	0	0
3. Local Board Grants ...	2,352	0	0	4. Cultivation charges, making sheds, etc.	1,001	6	3
4. Sale-proceeds of produce.	53	8	0				
				5. Feeding of stock ...	484	8	1
				6. Rent of school and sweeper charges.	1,343	15	7
				7. School furniture and book.	92	14	6
				8. Postage charges ...	24	0	0
				9. Tours of observation ...	51	2	0
				10. Travelling allowances to teachers.	246	12	0
				11. Miscellaneous office expenses.	658	0	0
				12. Wire fencing ...	1,199	13	3
				13. Purchase of implements .	150	3	0
				14. Sale-proceeds of produce, as per contra (sent to Poona treasury).	53	8	0
				15. Balance in hand ...	1,854	4	8
Total ...	12,264	10	1	Total ...	12,264	10	1

The fifth year of the school commenced on June 10th, 1914, in the new buildings erected for the purpose at Loni, G. I. P. Ry. A large number of applications for admission were received, but these were rigorously weeded out, and twenty-three boys were admitted, coming from districts as follows:—

Poona	2
Sátára	1
Sholápur	1
Ahmednagar	1
Násik	5
East Khándesh	1
Ratnágiri	1
Kolhápur State	1
Sángli State	2
Janjira State	1
Aundh State	3
Jamkhandi State	3
Other States	1

The school is in my opinion now a decided success. It is appreciated by the parents of the boys, some of whom frequently visit it; it has attracted largely the class of boys for whom it was designed and I think it will ultimately lead the way to a class of rural education which will be of great advantage to the mass of the village population of the country.

HAROLD H. MANN,
Principal.

APPENDIX C.

SUMMARY OF THE WORK DONE UNDER THE DEPUTY DIRECTOR OF AGRICULTURE, NORTHERN DIVISION, IN 1913-1914.

The work of the year has been a continuation of that of the previous year.

2. The Agricultural stations and demonstration plots in my charge during the year under report were as under :—

Name of Station.	Area.	Rainfall.	
		Average.	1913-14.
	A. g.		
1. Surat	273 32 (165 arable)	35·47	33·36
2. Nadiád (Kaira)	44 0	31·62	34·16
3. Dohad (Muvalia) (Panch Mahâls)	58 9	26·45	42·38
4. Dhulia (West Khándesh) ...	28 20	20·80	20·77
5. Jalgaon (East Khándesh) ...	204 31	27·51	23·90
Plots.			
1. Sisodra (Surat)	10 0	...	62·44
2. Bori (Broach)	1 10	...	...
3. Broach	13 28	...	43·79
4. Aslali (Ahmedabad)	3 10	...	...
5. Ahmednagar	15 28	22·68	22·99

3. The principal features of the season were an early setting in of the monsoon which is unusual all over the Gujarát though it was about the normal date in the Deccan and the absence of late rains in Gujarát and Khándesh.

4. The details of the results of different experiments tried on each station are given in the reports published separately for each station—a general line of the work done is given here. This consists of the following :—

1. Cotton.
2. Tobacco.
3. Food-grains.
4. Oil-seeds.
5. Fodder crops.
6. Rotational experiments.
7. Manurial experiments.
8. Tillage and cultural experiments.
9. Dry farming.
10. Implements and machinery.
11. Crop pests.
12. Shows, demonstrations and general district work.

1.—COTTON.

KHA'NDESH.

5. During the year the seed farm at Jalgaon was cropped with 98 acres and 22 guntha with Roseum cotton. This area has produced 15,000 lbs. of cotton seed of pure strain for distribution amongst the registered seed growers. Last year there were 13 seed growers (11 in Khándesh and 2 in Násik District). 7,310 lbs. of cotton seed were distributed among these growers and 11,408 lbs. were distributed to general farmers.

The fields of registered seed growers were purified by pulling out the plants of different types according to the lobes and flowers. This work took about 12 weeks (middle of July to middle of October). The charges of purification came to Rs. 218-1-0. The seed growers are quite convinced with the superiority of N. R. cotton. It has yielded well as the season was specially favourable to cotton in Khándesh. Special ginning tests of seed growers' cotton and ordinary cultivators' cotton were taken for comparison. The results obtained clearly show that the average ginning percentage of N. R. cotton is 37·18 against 34·50 of ordinary cotton from private farms. Owing to pure white colour of N. R. cotton the seed growers obtained better prices for their lint by about 3·9 per cent, *i. e.* Rs. 2-8-0 more per palla of 240 lbs. Cotton obtained from the Dhulia farm was sold in the local market at Rs. 63-6-0 per palla when the rate for local cotton was Rs. 57. To prevent adulteration the ginning was done under the supervision of the Departmental staff.

6. During the season of 1914-15, 97,977 lbs. of N. R. seed, including 6,700 lbs. from the Dhulia farm were available for distribution. This seed has been mostly distributed in the Khándesh Districts. 17,700 lbs. were sent to Sholápur and Nagar for distribution amongst the cultviators there.

During 1914 the number of registered seed growers has risen from 13 to 19 and the area from 362 to 732 acres as per details noted in the margin. Out of 16,555 lbs. of seed produced on the Jalgaon farm 8,300 lbs. were distributed amongst the registered seed growers, keeping 5,005 lbs. for emergency sowings and 3,250 lbs. for sowing on the farm.

	No. of cultivators.	Acreage.
East Khándesh—		
Amalner	1	21
Yáwal	2	50
Nagardevla (Páchora)	2	55
Varkheda (Páchora)	1	50
Chálisgaon	3	143
Ráver	1	15
West Khándesh—		
Pimpri (Dhulia)	1	30
Songir (Dhulia)	1	53
Shirpur	1	100
Dondiachi (Sindkheda)	1	40
Nandurbár	2	45
Násik—		
Málegaon	2	80
Tehre (Málegaon)	2	50
Total ...	19	732

7. At the time of the Sawda agricultural show a stall was specially opened to receive orders for N. R. seed from the visiting cultivators. It is very interesting to note that 6,457 lbs. of seed was sold on the spot. As previously arranged the seed from registered seed growers was purchased at 25 lbs. per rupee and sold to the farmers at 18 lbs. per rupee. Demand for pure seed was on an increase in spite of high prices which are charged for selected seed and which are more than double over the local rate (about 40 lbs. per rupee).

8. The hybrid Comilla × Bani that had given promising results last year on the Dhulia farm was again grown during the year. Two samples of selected cotton of this cross were sent for valuation to the Bombay Cotton Trades Association and were valued by them on the 17th June 1914 as under—

1. Surat like, Rs. 335 per candy,
2. Broach like, Rs. 310 per candy,

when Surat fine and Broach fine were valued at Rs. 325 and Rs. 300 respectively. A sample of Roseum cotton (N. R.) was valued on the same day at Rs. 250 per candy.

South Gujarát.

9. The arrangement for the cultivation and marketing of improved cottons in the Surat District described in last year's report was discontinued. However during the year under report it was intended to distribute about 250,000 lbs. of improved cotton seed covering an area of about 7,000 to 8,000 acres in British villages and about 3,000 acres in Baroda territory, amongst the cultivators of Athwa, Bhestan, Sayan, Bárdoli, Ránder and some of the villages of the Baroda State in the Surat District. But owing to continuous and heavy rains of June and July the cultivators were not able to prepare their lands and sow the seed in time and consequently the area was very much reduced under the farm cotton, the details of which are given below. The actual seed distributed amounted to 110,000 lbs.

Name of the group.	Area sown.	
	A.	g.
Athwa-Bhestan	1,948	34
Bárdoli	1,250	13
Ránder	441	26
	3,640	33

This year the seed was distributed unconditionally leaving the purchase of the cotton grown from seed distributed by the department to open competetion by local and outside merchants. The department supervised the growth of the crop. When the cotton began to come to the market none of the merchants came forward to purchase the same at a higher rate. The Divisional Inspector of Agriculture, Northern Division, therefore at the request of some of the leading cultivators arranged for the purchase with some of the local gin owners who paid Rs. 3 to Rs. 4 per bhar more over the prevailing market rate for some of this cotton.

10. The work of plant to plant selection was continued at Surat and the two promising cottons Selection I-A and Selection II were selected for better yield and ginning. During the year under report Selection II has again yielded the best, giving an outturn of 658 lbs. of seed cotton per acre with a ginning percentage of 37·78 per cent., while selection I-A has also ginned equally well though its yield is less than Selection II as in last year.

11. During the year the comparative trials with farm selected seed *versus* local seed were made as before and the results of last year are again confirmed, *viz.*: the farm cotton seed gives better yield over the local one.

NORTH GUJARÂT.

12. The local cotton Lalio which is grown both as an irrigated and dry-crop has given highest yield when sown in May and also when sown with rains and irrigated in cold weather; while Goghari another local variety has given higher yields both when irrigated and un-irrigated when sown with rains. Thus these two local cottons, one when sown early and the other with the monsoon have yielded better with 3 to 4 per cent. higher ginning than the introduced cottons. As for quality though Cambodia is valued better than the local cottons by the Bombay Cotton Trades Association and Messrs. Tata Sons and Co., the local merchants do not give higher prices to the growers of Cambodia cotton and hence there is no demand for Cambodia seed. Cultivators prefer varieties with better yield and higher ginning. Besides it has been observed during the year that the foreign cottons are more liable to insect pests and diseases. The trial of Cambodia on a large scale on the Nadiád farm referred to last year gave an average yield of only 565·8 lbs. of seed cotton per acre with a ginning percentage of 33·35.

DOHAD (PANCH MAHA'LS).

13. As in previous years Roseum cotton has yielded well. It averaged 667 lbs. of seed cotton per acre with a ginning percentage of 36·47. It being a hardy variety appears to succeed well even under heavy rainfall. It is satisfactory to note that some Bhils grew cotton successfully this year. It is reported that nearly 100 acres of cotton were grown in Dohad and Jhálod Tálukas.

2.—TOBACCO.

14. During the year white Burley tobacco was a failure—both Cavalla and local developed dark colour while curing in the barn. No marked results have been obtained with potash manuring to increase the potash contents of the tobacco leaf.

3.—FOOD GRAINS.

Wheat.

15. In comparative trials with various kinds of wheat at Dohad it appears that soft wheats are more suitable for the tract than hard wheats. Among soft wheats Pissi appears to be the best as will be seen from the following statement :—

Kind of Wheat.		Yield in lbs. per acre.
Soft White	Pissi	1,564
	Australian No. 25	1,248
	Hybrid Nagpur	1,227
Soft Red	Wagia	1,274
Hard White	Shet Parner	1,506
	Dhola Katha	1,052

The hard wheats have always a tendency to turn spotted when grown under irrigation and hence it does not fetch higher prices in the bazar which demands soft wheats.

The selection work on wheat is in progress at Nadiád, Dohad and Dhulia.

Jowar.

16. The selection was continued at Surat on the same lines as in past years. In a comparative trial the selected seed gave about 300 lbs. of more yield per acre than the bazar seed.

Rice.

17. The successful growing of paddy on the Dohad farm has induced some people to prepare rice beds on the canal area. Nearly 12 acres of land has been converted into kairi. The yields of paddy on the farm were again satisfactory. Kamod yielded 1,890 lbs. and Sutarsal gave 2,172 lbs. per acre.

At Nadiád the experiment of transplanting of rice with one, two and three seedlings in a bunch, was continued during the year. The comparative results show that transplanting with two and three seedlings have given best results, yielding 2,115 and 2,146 lbs. of paddy per acre.

4.—OIL-SEEDS.

Groundnuts.

18. *Dohad.*—Comparatively large area was put under groundnuts round about Dohad by cultivators. 6000 lbs of seed was distributed, but the unfavourable weather and the appearance of rats during the year prevented satisfactory results.

Spanish peanuts on the Surat farm gave good results with an outturn of 1,364 lbs. per acre, while at Dhulia it gave a high yield up to 2,400 lbs. of nuts per acre leaving a nett profit of Rs. 118.

In all 11,000 lbs. of Spanish peanuts were distributed in Gujarát and 13,000 lbs. in Khándesh District. This shows that the crop is becoming more and more popular amongst the cultivators.

Til.

19. At Dhulia the year was favourable to til crop—it yielded on an average up to 620 lbs. per acre with a nett profit of over Rs. 40.

5.—FODDER CROPS.

20. Experiments in emergency fodders were continued on the Nadiád farm. In this trial sundhia, chino, kang, maize, banti and lucerne were compared. These were sown in the middle of each month commencing from August with a view to ascertain their yields when sown at different times of the year. From the results it has been observed that the Maize when sown in the months of October, November and December has given the best yields from 10,000 lbs. in December to 17,000 lbs. of green fodder per acre in October. Sundhia has given the best results when sown in August, March and April. The yield varying from 10,500 lbs. in April to 13,800 lbs. in August and March. Kang appears to be suitable for growing at any period extending over a greater part of the year but it yields well when sown in October, November and March. Chino is a very poor yielder when compared with other class of fodders. Banti gives best results when sown in the months of October, February and March. The yields per acre varying from 10,000 lbs. of green fodder in February to 14,000 lbs. in March. Lucerne when sown in September, October and November has given the best results giving 5 to 6 cuttings, the total yield being from 18,000 lbs. to 21,000 lbs. per acre.

The growing periods of these fodders vary from 6 weeks to 10 weeks. The earliest being chino and the latest being banti. Maize, sundhia and kang take about two months to mature.

In point of cost of production lucerne is the cheapest fodder, while sundhia, kang and maize stand next to it. The chino and banti seem to be the dearest of the lot.

Berseem.

At Dohad Berseem was sown broadcast in the standing crop of cotton in the month of November. The yield came to 9,000 lbs. of green fodder per acre with 10 irrigations.

Sundhia jowár sown on the Surat farm on black soil gave on an average 3,000 lbs. of dry fodder per acre and guinea grass yielded 15,800 lbs. of green fodder per acre in nine cuttings. The ensilage on the Surat farm cost Rs. 4-2-4 per 1,000 lbs. The total quantity of ensilage obtained was 64,800 lbs. from 90,000 lbs. of green fodder put into the silo. The silage supplied the dairy cattle with succulent fodder in the hot weather.

21. Arrangement has been made to supply pure, genuine lucerne seed to cultivators in the Nagar District by storing the same on the Nagar farm. It has also been stored on the Surat farm for sale to Gujarát cultivators. In all 211 lbs. of seed was distributed in Gujarát and 191 lbs. in the Nagar District.

6.—ROTATIONAL EXPERIMENTS.

22. In the rotation experiments at Dhulia it has been observed that out of the following four rotations:—

1. Bájri-cotton,
2. Til-cotton,
3. Udid-cotton,
4. Fallow-cotton,

the rotations Nos. 1 and 2 seem to be the best as they have left the highest profit of about Rs. 72 per acre, but til being a risky crop in Khándesh, the most suitable rotation for cultivators of small holdings seems to be bájri-cotton, because bájri furnishes fodder for cattle and grain for the family.

In order to ascertain whether rice followed by a rabi crop pays better than maize and gram, an experiment has been laid out at Dohad in which rice followed by gram was compared with maize-gram. The results are in favour of the latter as the rabi crops do not thrive well in rice fields on account of too much moisture at the time of sowing. The following will give an idea of the varying yields obtained on the Dohad Farm :—

	Yield per acre in lbs.
A.—Rice	1,765
Gram	367
B.—Maize	642
Gram	1,674

On the black soil of the Dohad Farm Roseum cotton alone gave a profit of Rs. 37-11-3 against a double crop of maize and gram which gave a profit of Rs. 19-4-10 per acre.

7.—MANURIAL EXPERIMENTS.

23. The bulky manure experiments on the Surat Farm are in progress for the last 6 years and the results obtained are very interesting and instructive. The manures are applied every second year before cotton which rotate with jowár. The following table summarizes the results :—

Manurial treatment at the rate of 5 tons per acre.	Average yield per acre in lbs.	
	Cotton.	Jowár.
1. Rotted cactus	396	595
2. Mohwra refuse	447	739
3. Poudrette	532	891
4. Farm-yard manure	438	633
5. Town sweepings	406	609
6. No manure	369	520

At Surat fresh night soil applied in 1911 has given a yield of 921 lbs. of seed cotton and 1,749 lbs. of jowár with 6,342 lbs. of kirbi per acre as against 569 lbs. of seed cotton and 1,261 lbs. of jowár with 3,864 lbs. of kirbi per acre in no manure plot.

24. On the Nadiád Farm in an experiment in which different kinds of cakes were tried for 4 years as a top dressing for tobacco, the following results were obtained :—

Name of manure per acre.	Average yield of 4 years in lbs. per acre.
Farm yard manure 20,000 lbs.	1,550
Farm yard manure 20,000 lbs. + Cotton seed cake 1,000 lbs.	1,942
Farm yard manure 20,000 lbs. + Castor cake 1,000 lbs.	2,110

25. A small plot measuring 3 acres, 10 gunthas was secured in 1911-12 at Aslali in South Daskroi (Ahmedabad District) mainly with the object of improving the rice yield of the tract by good cultivation after harvest and by application of cheaper manures such as green manures of san and indigo as against the costly application of castor cake which has in recent years become prohibitive to many of the ordinary cultivators. The plot is situated in the rice tract of the district. The results obtained are tabulated below :—

Plot No.	Area in gunthas.	Manurial treatment per acre.	Yield per acre in lbs.	
			Grain.	Straw.
1	15½	San green manure seed rate 60 lbs.	2,284	1,855
2	14½	San seed 160 lbs. sprouted seed sown broad cast ...	1,821	1,789
3	11	16 cart loads of Farm yard manure	1,680	1,909
4	13	Castor cake 600 lbs.	1,769	1,569
5	9	No manure	1,333	1,844
6*a*	8	No manure	825	950
6*b*	8	Indigo green manure 13 lbs.	1,150	1,050
7	21	2 days sheep folding 2,000 animals	1,225	971
8	24	16 cart loads of Farm yard manure	1,666	1,250

It will be seen that the yield is higher in both the plots manured with san and san seed. Castor cake plot stands next to san. The plot treated with san was so attractive that several of the cultivators have made up their minds to try san next season on a large scale.

8.—TILLAGE AND CULTURAL EXPERIMENTS.

26. At Surat the experiment in which deep ploughing with gallows plough was compared with the ordinary practice of harrowing was continued. The results obtained go to show that jowár has done better in the plots treated in the ordinary way while cotton has done well in the deeply ploughed plots, but the excess produce in cotton has not compensated the cost of ploughing.

To test the advantage of dibbling over drilling the experiments are in progress on the Surat Farm for the last 5 years. The results obtained are in favour of dibbling. During the year the yield of dibbled plot was 436 lbs. of seed cotton per acre against 307 lbs. of drilled plot.

It is very interesting to note here that the cultivators in the Surat District have of late been extending the practice of dibbling cotton seed on plots instead of the usual method of drilling as they have found that the dibbled seed is more safe than the sown one, even though the rainfall is heavy after dibbling. Another advantage of this method is that the field could be intercultured both the ways and kept clean at a small cost with less labour. The dibbled crop withstands deficient rainfall better than the sown one as it has more space on all sides.

27. In the experiment in which the early and late sowings of jowár and cotton are compared, the results obtained indicate that the sowings done in the middle of August give satisfactory results.

9.—SOIL MOISTURE CONSERVATION EXPERIMENTS (DRY FARMING).

28. The Ahmednagar temporary station is situated about 2 miles to the north-west of Ahmednagar. The soil of the plot is black with an area of 15 acres; the staple crops being jowár, wheat and gram. There is another plot of 17 acres close to the above belonging to the Agricultural Association placed at the disposal of the Agricultural Department.

The following statement gives the rainfall of the year.

Rainfall for the month of.	Durirg 1913-14.	Average.
April	...	1·06
May	0·39	0·78
June	10·21	5·84
July	6·80	3·14
August	1·70	2·06
September	2·83	7·12
October	1·78	2·00
November	...	0·41
December	...	0·27
January	...	...
February	...	...
March	...	...
Total ...	23·71	22·68

Season.

29. The total rainfall at Nagar amounted to 23·71 inches, which is little more than the average and so the year under report was not particularly favourable for such work as soil moisture conservation. There were few anti-monsoon showers which proved very useful for commencing the preliminary operations. The regular monsoon set in on the 7th of June with a rainfall of 3·80 inches. This rain was sufficient to prepare the fields and commence sowing operations. The fall in June and July which was well distributed helped the standing crops bajri and cotton for their healthy growth. The August rainfall was rather insufficient. The rainfall during the month of September and October was quite opportune and proved of great value in raising successful rabi crops. On the whole the season was favourable and changed the whole aspect of the tract, the previous year being a famine year.

30. There was no serious attack of any pest except the appearance of grass hoppers in the Rahuri and Kopergaon tálukas; and the damage from this attack was very little.

31. The experimental work on the Association plot and on the Departmental plot is reported under the following sections.

1. Association plot—
   (*a*) Cultural experiments,
   (*b*) Crop experiments,
2. Departmental plot—
   (*a*) Cultural experiments,
   (*b*) Manurial experiments.

ASSOCIATION PLOT.

(a) Cultural experiments.

32. The object of the experiment is—

(*i*) To carry over the moisture of one year by fallowing and then to raise one crop in two years,

(*ii*) To increase the absorbing power of soil for water by means of superior and fine tillage. The usual practice among cultivators is to harrow the land once or twice,

(*iii*) To lessen the loss of moisture from evaporation, by maintaining an earth mulch by frequent inter-tillage.

33. In order to attain the above object a plot of 7 acres has been set apart and divided into two sub-blocks called respectively the Kharif and Rabi blocks. Each sub-block is again sub-divided into 6 plots of 24 gunthas each, so that there are altogether 12 plots in the two blocks including 4 control plots. These control plots receive ordinary treatment given by a good cultivator. A permanent rotation series for 5 years has been initiated for this block.

34. During the year under report the Kharif block was sown with bajri and cotton and the rabi block with jowar and gram respectively. Each block has two fallow plots kept under proper tillage for being cropped next year. The results obtained are summarised below from which it will be seen that the plots receiving good tilth have in all cases except one given better results than the control plots.

Plot No.	Crop.	Treatment.	Yield per acre in lbs.		Value of Produce per acre.	Cost of cultivation per acre.
			Principal product.	Bye-product.		
					Rs. a. p.	Rs. a. p.
1	Bájri ...	Superior tillage	550	1,475	30 4 8	16 2 2
3	Do. ...	Ordinary ,, ...	460	1,292	25 10 0	9 12 8
2	Cotton ...	Superior ,, ...	616	...	64 2 6	20 4 2
4	Do. ...	Ordinary ,, ...	455	...	47 6 4	14 12 3
7	Jowár ...	Superior ,, ...	860	2,375	52 6 8	16 4 7
9	Do. ...	Ordinary ,, ...	680	1,587	38 3 4	12 13 1
8	Gram ...	Superior ,, ...	317	233	15 9 4	18 2 10
10	Do. ...	Ordinary ,, ...	400	315	19 12 11	14 7 8

(b) Crop experiments.

No. 1.

35. The object of this experiment is to ascertain the advantages of mixed cropping which is so much in vogue in almost all the parts of the Presidency against a single cropping. For this, pure crops of safflower, tur, mug, til, groundnut, etc. have been grown. The results obtained are summarized below, but in order to arrive at some definite conclusion the experiments should be conducted for a series of years. No doubt the principal advantage in mixed cropping lies in the security against serious damage to any one crop and less exhaustion of a particular element of plant food in the soil. Besides cultivators of small holdings get all their requirements in small quantities by this method of cropping. The results obtained are tabulated below—

Plot No.	Crop.	Yield per acre in lbs.		Value of produce per acre.	Cost of cultivation per acre.	Remarks.
		Principal product.	Bye-product.			
				Rs. a. p.	Rs. a. p.	
13	Safflower	620	.....	31 0 0	12 4 10	It will be seen that the groundnut as a dry crop has yielded well. Mug and tur suffered from aphis. Tur which was sown 18" apart grew so thick that the plants developed only a few pods. The experiment will be repeated and tur will be given wider spacing.
14	Tur	312	68 Bhusa. 1,962 stalks.	24 2 10	13 14 0	
15	Til	296	.....	18 2 0	10 7 8	
16	Mug	384	240	18 6 0	14 0 0	
17	Groundnut—Spanish peanut.	588	716	38 11 6	14 5 2	
18	Bájri with local mixture.	276	600	18 0 0	11 4 10	
...	Tur	20	.....	.....	.....	
...	Kala	54	.....	.....	.....	
...	Mug	12	.....	.....	.....	

Experiment No. 2.

36. In this experiment an early variety of groundnut (Spanish) was grown in alternate rows with Bájri. The results obtained are encouraging and the groundnut bájri mixture brings a larger nett profit than when Bájri is grown with the local mixtures of til, tur, etc. The results are tabulated below—

Plot No.	Crop.	Yield per acre in lbs.		Value of yield per acre.	Cost of cultivation per acre.	Remarks.
		Principal product.	Bye-product.			
				Rs. a. p.	Rs. a. p.	
18	Bájri with local Mixture ...	276	600	18 0 0	11 4 10	The groundnut in the Bájri plot turned yellow owing to the shade of the bájri crop and this slightly affected the outturn. Next year groundnut will be grown in alternate strips instead of alternate rows.
...	Rala	54	...	.....	.....	
...	Tur	20	...	.....	.....	
...	Mug	12	...	.....	.....	
19	Bájri with Groundnut ...	242	600	25 5 0	11 9 0	
		172	316			

DEPARTMENTAL PLOT.

(a) Cultural Experiments.

37. These experiments consisted of ploughing, different seed rate, spacing and superior and ordinary tillage.

Experiment No. 1.

In this experiment good cultivation including ploughing has been compared with poor cultivation with harrowing alone. The crop in the plots which received good cultivation was more healthy and vigorous than in the ordinary cultivated plot. The crop in plots 5 N and 8 N rather suffered from washings during the periods of heavy rainfall on account of their low situation. All the plots were cropped with Rabi jowár. The results are tabulated below—

No of plot.	Crop.	Treatment.	Yield per acre in lbs.		Value of Produce per acre in Rs.	Cost of cultivation per acre in Rs.
			Principal product.	Bye-product.		
1 S	Jowár ...	Good cultivation ...	1,066	1,541	50 15 2	15 6 5
2 S	„ ...	„ ...	816	1,680	43 15 11	14 8 8
3 S	„ ...	„ ...	1,056	1,570	50 14 5	13 14 5
4 S	„ ...	„ ...	896	1,773	47 8 8	14 9 1
5 S	„ ...	Poor cultivation ...	672	1,317	35 9 2	9 10 0
6 S	„ ...	„ ...	560	1,365	32 5 0	9 5 10
7 S	„ ...	„ ...	640	1,160	32 14 11	8 11 9
8 S	„ ...	„ ...	597	1,853	38 6 9	9 3 9
1 N	„ ...	„ ...	720	1,400	38 0 0	7 12 8
2 N	„ ...	„ ...	544	1,408	32 3 4	9 6 8
3 N	„ ...	„ ...	648	1,224	33 10 0	9 11 5
4 N	„ ...	„ ...	608	1,680	37 1 0	8 15 9
5 N	„ ...	Good cultivation ...	768	1,584	41 4 5	15 12 8
6 N	„ ...	„ ...	752	1,488	39 14 10	14 15 4
7 N	„ ...	„ ...	773	1,440	39 2 7	14 9 1
8 N	„ ...	„ ...	792	1,858	44 15 6	15 14 5

It will be seen from the results that good cultivation not only gave higher yield, but the yields obtained have more than compensated the extra expenditure on account of ploughing, etc.

Experiment No. 2.

Full seed rate versus half seed rate.

38. This experiment has been planned to ascertain whether ordinary seed rate is an economical one, as in other arid countries it is thought that thin seeding gives better stand of plants owing to individual plants getting sufficient moisture.

This experiment is also combined with an experiment of wider spacing.

The results are tabulated below—

Plot No.		Crop.	Treatment.	Yield per acre.		Value of Produce per acre in Rs.	Cost of cultivation per acre in Rs.
				Grain in lbs.	Bye-product in lbs.		
Good cultivation.	1 S	Jowár ...	Full seed rate 18″ .	1,066	1,541	50 15 2	15 6 5
	5 N	,, ...	,, ,, ...	768	1,584	41 4 5	15 12 8
Poor cultivation.	5 S	,, ...	,, ,, ...	672	1,317	35 9 2	9 10 0
	1 N	,, ...	,, ,, ...	720	1,400	38 0 0	7 12 8
Good cultivation.	3 S	,, ...	Half seed rate 18″ .	1,056	1,570	50 14 5	13 14 5
	7 N	,, ...	,, ,, ...	773	1,440	39 2 7	14 9 1
Poor cultivation.	3 N	,, ...	,, ,, ...	648	1,224	33 10 0	9 11 5
	7 S	,, ...	,, ,, ...	640	1,160	32 14 11	8 11 9
Good cultivation.	2 S	Jowár ...	Full seed rate 9″ ...	816	1,680	43 15 11	14 8 8
	6 N	,, ...	,, ,, ...	752	1,488	39 14 10	14 15 4
Poor cultivation.	2 N	,, ...	,, ,, ...	544	1,408	32 3 4	9 6 8
	6 S	,, ...	,, ,, ...	560	1,365	32 5 0	9 5 10
Good cultivation.	4 S	,, ...	Half seed rate 9″...	896	1,773	47 8 8	14 9 1
	8 N	,, ...	,, ,, ...	792	1,858	44 15 6	15 14 5
Poor cultivation.	4 N	,, ...	,, ,, ...	608	1,680	37 1 0	8 15 9
	8 S	,, ...	,, ,, ...	597	1,853	38 6 9	9 3 9

It will be observed that the first series with 18″ drill give rather conflicting results. In a good season like the present one the question of seed rate does not seem to be an important one. But in years of scanty rainfall the certainty of a crop can be greatly insured by thinner seeding.

In the second series sown with 9″ drill the thinner seeding has given increased yield both n grain and kirbi.

Experiment No. 3.

Superior versus ordinary tillage.

39. Superior tillage consisted in ploughing land with an iron plough and ordinary with a country plough. The results set forth in the following statement go to show that superior tillage has given increased yields both in grain and kirbi.

Plot No.	Crop.	Treatment.	Yield per acre.		Value of produce per acre.	Cost of cultivation per acre.
			Grain in lbs.	Kirbi in lbs.		
					Rs. a. p.	Rs. a. p.
9	Jowár ...	Perfect treatment with iron plough.	703	3,470	58 2 1	22 8 9
10	,, ...	Control	565	2,438	43 3 5	19 1 0
11	,, ...	Perfect treatment with country plough.	690	3,346	56 7 4	22 9 10

(b) Manurial experiments.

40. The experiments were laid out during the year 1912-13 in order to ascertain whether quick acting artificial manures could be substituted in whole for the farm yard manure on the dry crops in arid tracts. Tur and cotton were sown in this area but they failed to give any results owing to famine conditions. During the year under report this area was sown with jowar to study the residual effects of artificials. In addition to no manure plot there was a control plot manured with farm yard manure for comparison. The results obtained are summarized below—

Plot No.	Manure applied.	Yield per acre.		Value of Produce per acre.	Cost of production per acre.	Remarks.
		Grain in lbs.	Kirbi in lbs.			
				Rs. a. p.	Rs. a. p.	
12	K	816	2,140	48 9 6	15 6 8	As the present experiments are merely residual the cost of manure has not been taken into consideration in the cost of production.
13	K + P	868	2,420	53 10 4	13 2 8	
14	K + N	924	2,160	52 6 2	15 7 8	
15	K + P + N	1,248	3,880	81 14 8	15 4 8	
16	No manure	768	2,000	45 9 8	14 4 8	
17	F. Y. M.	1,068	2,496	58 9 0	17 0 8	
18	P	1,272	3,132	73 11 4	15 10 8	
19	P + N.	1,776	3,016	89 4 8	16 12 8	
20	N	1,248	1,760	69 3 8	18 8 8	

It will be seen that the results are in favour of artificials, but the cost of manure is too great to permit of any profit. It is very doubtful whether artificials will ever pay for dry crops in dry tracts.

10. IMPLEMENTS AND MACHINERY.

41. In addition to the French plough referred to in the last year's report another Bajac plough was obtained from France for use in Guzerat. The total cost of this plough landed at Kim (táluka Olpad, district Surat) with bullocks and local accessories such as yokes, etc, amounted to Rs. 5,800. Total work done by both these ploughs amounted to 73 acres, 9 gunthas. The rate of Rs. 20 was increased to Rs. 25 per acre during the year. It appears that this rate will have still to be materially increased in order to make the concern a financial success.

As usual the gallows plough is more appreciated by cultivators of South Guzerat for heavy soils as it could be worked in the hot weather for breaking up new lands or for eradicating deep rooted weeds. In North Guzerat the lighter ploughs such as BT2 and Hindustan are in favour of cultivators for ploughing lands during the rainy season as against the local plough.

42. In accordance with the orders passed in Government Resolution No. 1165, dated 28th March, 1912, Financial Department, arrangements were made to open Depôts of improved implements for hire to cultivators in different localities. Three depôts have since been opened at Malegaon (Nasik), Vadala (Nagar) and Hadapsar (Poona). At these depôts, ploughs, harrows, hand hoes, road scrapers (levellers) and reapers are kept for hire to cultivators at a moderate charge. The hire charges realized from these three depôts amounted to Rs. 128-15-0 during 1913-14. The cultivators have begun to appreciate the value of these implements as will be seen from the fact that nearly 10 CT 2 ploughs in Malegaon, and 9 ploughs, 10 hoes and 1 scraper in Nagar have been sold to cultivators.

11. CROP PESTS.

43. Owing to the appearance of potato moth (Pthorimoea operculela) in stored potatoes experiments were undertaken at Khed during 1913-14 to find out the best method of storing potatoes. For this purpose a small well ventilated house was hired and potatoes were stored according to the following methods after fumigating the same with petrol.

I. Stored on racks in layers of about six inches.

II. Stored in sand as under—

A four inch layer of sand was made on the floor and potatoes were spread over it to a depth of about 6 inches. The whole space thus occupied by potatoes was covered over with sand.

At an interval of every three weeks they were inspected and the rotted potatoes were picked out and buried. In 1913 the moth did not make its appearance at all and hence the results could not be compared with those obtained by the ordinary methods adopted by the cultivators. But during the season of 1914 these methods of storing were repeated when the moth appeared about the middle of April. The results of the two methods above mentioned show that the percentage of rotted potatoes on racks was 12·9 per cent. against 51·7 per cent. in sand, while dryage was 20·8 per cent. on racks against 18·2 per cent. in sand. The cultivator's method of storing causes proportionately more rotting, *viz.*, 17 per cent. than the method of storing on racks but the percentage of dryage is less in the cultivator's method. The experiments will be tried further.

44. Steeping experiments were further carried out on the Surat station with the result that the area sown with jowar seed steeped in 2 per cent. solution of copper sulphate for 10 minutes had no smutted heads at all, while the area sown with unsteeped seed contained 578 smutted heads in a plot of one acre.

45. In north Guzerát the hairy caterpillar (Amsacta Moorie) is a serious pest. To find out successful remedial measures against this pest experiments of light traps, etc., were carried out on the Nadiad Farm. The results obtained are not conclusive, but it appears that a strong dazzling light would attract a large number of moths including females. The other remedy which suggests from the habit of these moths is to catch them in the evening when they emerge in greatest number. These moths are very sluggish and generally do not fly during the day and hence if village boys and girls were told to hunt after them for a couple of hours in the evening these can be easily caught. There is another precautionary remedy consisting of collecting the eggs of these caterpillars. When these moths begin to appear in great number, search should be made for a few days for the eggs on the under side of the leaf of cactus, arni and other young crops such as castor, til, cotton, etc. A large number of egg masses can be collected by this method. When the caterpillars grow larger in size they can be caught by sweeping hoppersbags over young crops in the morning and evening. Similarly if infested fields are ploughed up to a depth of 4 to 6 inches after the crops are harvested most hibernating pupae of these caterpillars might be exposed and thus destroyed by heat and cold.

46. Remedial measures were taken as usual against other minor pests which have been described in detail in the annual report of the stations separately published.

12. SHOWS, DEMONSTRATIONS AND GENERAL DISTRICT WORK.

During the year under report there were 28 demonstrations and shows held in different parts of Guzerat and Deccan as shown in the margin. These were organized along with Durbars held by the District officers, in connection with religious annual fairs, on Government Farms and in some cases in the far interior of the district. Out of these, the shows held at Sawda and Khed were on a large scale. At the former place there were a large number of exhibits of cotton, jowar and plough bullocks, while at the latter, samples of various kinds of grains, vegetables were exhibited. At Khed the number of cattle was very large and well represented. At the above shows and demonstrations a large number of intelligent cultivators and officers were present.

	Deccan.		
1.	Dhulia (West Khándesh)	... ...	5-10-13
2.	Nashirabad (East Khándesh)	... ...	26-10-13
3.	Jejuri (Poona)	... ...	3-12-13
4.	Násik	... ...	27-12-13
5.	Sawda (East Khándesh)	... ...	8 to 10-1-14
6.	Chandanpuri (Násik)	... ...	12-1-14
7.	Bej, Sule and Kalwan (Násik)	... ...	20 to 25-2-14
8.	Khed (Poona)	... ...	5 to 7-3-14
	Guzerat.		
9.	Athwa Farm (Surat)	... ...	7-12-13
10.	Degaum (Surat)	... ...	30-10-13
11.	Sidhanath (Surat)	... ...	9-12-13
12.	Vijaipur (Surat)	... ...	26-12-13
13.	Wagra (Broach)	... ...	22 and 23-10-13
14.	Shuklatirth (Broach)	... ...	12 to 14-11-13
15.	Bojadra (do.)	... ...	8-11-13
16.	Vedachha (do.)	... ...	18-11-13
17.	Amod (do.)	... ...	23-1-14
18.	Broach	... ...	17 and 18-2-14
19.	Jambusar (Broach)	... ...	23-2-14
20.	Chamargaon (Broach)	... ...	18-3-14
21.	Kalol (Panch Mahals)	... ...	5-1-14
22.	Dohad Farm (Panch Mahals)	... ...	18-1-14
23.	Sonasan (Ahmedabad)	... ...	12-5-13
24.	Gadi (do.)	... ...	7-10-13
25.	Vavtha (do.)	... ...	12-14-11-13
26.	Dhanduka (Ahmedabad)	... ...	21-11 13
27.	Sarkhej (do.)	... ...	16 and 17-1-14
28.	Dakor (Kaira)	... ...	14 to 16-10-13

48. In addition to this, parties of cultivators from the Central Division were brought to the College Farm to show them the excellent crops grown on the Farm and the working of improved implements, etc. Similarly, small parties of cultivators were brought on the Surat Farm and were shown the standing crops and the use of the improved implements. The effect of all these demonstrations and shows was a far reaching one.

49. Over and above these demonstrations, the demonstration of steeping seed as a preventive against smut mentioned in para. 59 of the last year's summary report was also continued in the Broach district. The area so treated amounted to 5,234 acres. The results of these were very encouraging as in none of the treated fields the smutted heads appeared while in

untreated fields the percentage of smutted heads varied from 5 to 33 per cent. Owing to such conclusive results the Department has arranged to keep with the District Overseer small packets of copper sulphate with printed instructions for its use for sale to cultivators.

50. Demonstration of Poona furnace was carried on in about 15 places in the Násik district. Consequently several sugarcane juice boiling pans of the Poona type were sold and the people have begun to appreciate the value of Poona method of preparing gul.

51. The district work also consisted of trials of different crops such as cotton and groundnuts and of cakes, artificials and san manuring on plots of land placed at the disposal of the Department by the members of the various agricultural associations and private individuals. These served as ocular examples to the neighbouring cultivators. The plots were supervised by the District Overseers from time to time. A summary of the results on these plots is given below :—

Poona District.

1. San as green manure for rice was tried on several plots in the Mawal tract but owing to the heavy early rains it failed to give any results except at one place (Paud) where a green manure plot gave 317 lbs. of rice, plus 386 lbs. of straw more than the ordinary manured (farm yard manure) plot.

2. Spanish peanut, the early variety of groundnut is likely to be more successful on the light soil on sloping portions in the Máwal where oil seeds like niger seed are usually grown. The yield of the plot at Paud came to 2,933 lbs. of nuts per acre.

3. In Máwal a very inferior kind of wheat called Potia is cultivated. It is a very poor yielder and Shet Parner wheat from Nagar District was grown at two places (Karla and Naigam) in Mawal. In both the places it yielded more than the local by about 56 lbs. per acre. The yield was greatly affected owing to the failure of the late rains.

Sugarcane.—Cottonseed cake as a manure for top dressing sugarcane was tried on two plots on the Mutha Canal and two on the Nira Canal. The object of giving trial to this cake is to see its effect on sugarcane in comparison with other cakes. This cake was applied in comparison with fish manure, castor cake and safflower cake giving 200 lbs. of nitrogen per acre in addition to the usual dressing of Farm yard manure. The yields obtained are in no way better than the other cakes which are usually given by the cultivators. The gul obtained was of better quality and the percentage of juice to gul was higher than in the case of other manures.

Khandesh.

Sawda demonstration plot.—Here three varieties of groundnut (Local, Big Japan and Spanish peanut alone and with cotton) N. R., N. R. C., and Varadi were sown side by side in small plots to demonstrate these crops to the cultivators in connection with the show held there. The soil of the plot was deep black and heavy. Among the groundnut varieties, Big Japan yielded well giving 2,868 lbs. of nuts per acre without irrigation. The N. R. cotton gave a good yield of 614 lbs. of seed cotton per acre.

A small plot of chillies manured with artificials in comparison with farm yard manure was laid out. The artificial manured plot gave 780 lbs. of green chillies more than the ordinary manured plot.

Nashirabad.—Here groundnut and cotton were grown on small plots for demonstration held at this place. As usual the Spanish peanuts gave good yield of 1,760 lbs. per acre. On this plot N. R. C. yielded 596 lbs. of seed cotton per acre against 532 lbs. of N. R..

Bahal (Jamda).—Here three varieties of groundnuts were tried. Local, Big Japan and Spanish peanuts were grown under irrigation. Spanish peanut was grown in the space between fruit trees and received no irrigation. Big Japan and local received four irrigations each. They yielded respectively 3,240 lbs. and 2,825 lbs. of nuts per acre. The yield of Spanish peanut was 920 lbs.

Nawapur.—Big Japan and Spanish peanut varieties were also sown at Nawapur a heavy rainfall tract in Khándesh. The Big Japan yielded at the rate of 2,190 lbs. of nuts per acre while the Spanish peanut gave 1,250 lbs.

Ahmednagar District.

Sugarcane.—Safflower cake alone and safflower cake in conjunction with ammonium sulphate were given as top dressing to sugarcane in two places at Aswi (Sangamner). There was a slight increase in the yield from the plot manured with safflower cake and ammonium sulphate in both the cases.

Safflower cake and ammonium sulpate were used in comparison with castor cake as top dressing at Rahta (Kopergaon). The results are in favour of the former giving about 523 lbs. of more gul per acre over the castor cake plot and 1,668 lbs. over the no manure plot.

Ahmedabad District.

Aslali.—At Aslali in Dáskroi táluka a trial was made by applying ammonium sulphate to the sugarcane crop at the rate of 800 lbs. per acre in comparison to a plot manured with

sheep folding. The plot treated with ammonium sulphate yielded 1,600 lbs. gul more than the plot treated with sheep folding which yielded 8,000 lbs. of gul.

Moyed.—At Moyed in Prántij the Nadiad castors yielded 1,333 lbs. per acre against the local variety which yielded 640 lbs. per acre.

Broach District.

Nitre was tried at two places at Chingaspura in Broach Táluka and at Jambusar on two crops, *viz.*, onions and potatoes at the rate of 220 lbs. per acre in addition to 17 tons of farm yard manure in the case of onions and sheep folding worth Rs. 12 in the case of potatoes. The onions yielded 14,960 lbs. more per acre in comparison to the ordinary treated plot which yielded 24.560 lbs. The potato yielded 4,880 lbs. more per acre than the ordinary plot which yielded 11,760 lbs.

A mixture of 125 lbs. of ammonium sulphate, 100 lbs. of potassium sulphate and 50 lbs. of superphosphate per acre was applied to tobacco in addition to 10 tons of farm yard manure per acre at Kareli (Jambusar). The tobacco crop of the plot treated as above gave 920 lbs. more yield than the untreated plot which yielded 2,720 lbs.

Three plots, two at Tham in Broach táluka and one at Buva in Amod táluka were kept for trying groundnut and cotton in alternate rows and they have all given satisfactory results.

Surat District.

At Talavchora in the Chikli Táluka a trial on sugar-cane was made by applying ammonium sulphate in comparison to castor cake which is usually applied as topdressing. The plot treated with ammonium sulphate yielded 1,005 lbs. of gul more per acre than the plot treated with castor cake which yielded 7,620 lbs. per acre.

52. During the year under report a quarterly magazine in Guzerati has been published by the Broach Agricultural Association. The Divisional Inspector of Agriculture, Northern Division, is on the publishing committee and it is hoped that this magazine will become popular among the cultivators. As an encouragement, five hundred copies of this magazine have been subscribed by Government.

G. K. KELKER,

Poona, 15th August 1914. Acting Deputy Director of Agriculture.

APPENDIX D.

SUMMARY OF WORK DONE UNDER THE DEPUTY DIRECTOR OF AGRICULTURE, SOUTHERN DIVISION, DURING THE YEAR 1913-14.

Experimental work on the Farms at Dhárwár and at Gadag has now been in progress for some years, and in the reports on these Stations details will be found describing the stage to which several experiments have now attained. A few conclusions have been drawn and are mentioned below in their appropriate places. In other cases summaries have been written, without attempting any conclusion, though indicating the general trend of the results. Especially in the case of experiments dealing with small differences, is it impossible to draw up comparisons based on a few figures only.

COTTON.

Trials of foreign varieties are now excluded from the Dhárwár Farm programme, though some are still grown on a very small scale for educative purposes. American varities are yet under trial at Gadag, and Egyptian and Bourbon at Gokak. Bourbon bore an excellent crop of 738 lbs. of seed cotton in this its third year. Negative results preponderate over positive in numbers as it is naturally to be expected. The work which has led to the establishment of Broach Cotton and of Kumpta cross as suitable for the Southern Mahratta country has been described in previous reports. Other selected strains are showing progress in the directions sought, but fixed lines have not been secured—a cross Christopher X Culpepper produced in 1905 and since multiplied, and selected on the Gadag Farm, is described in the following terms by Messrs. Tata & Sons, Bombay.

"This is a very long stapled and strong fibred cotton. Every way desirable stuff. This deserves to be widely cultivated."

Careful attention will in future be paid to this cotton, as its yield and ginning percentage are also good.

Sholápur cottons typical of each táluka are grown on the Bársi plot. The preponderating variety is Varadi, American and Kumpta are mixed with it. Imported Neglectum roseum gave the following yields :—

Sholápur	... 1,510 lbs. per acre	...	Irrigated 4 times.
Do.	... 914 lbs. do.	...	Do. once.
Pangri	... 1,875 lbs. do.	...	Grown amongst lime plants and irrigated every 8th day.

An attempt is being made to distribute this cotton. In a normal year it offers almost certain chance of success as a dry crop.

The auctions of Broach and Cambodia cottons were again undertaken by the Department at Dhárwár and at Gadag, and a net profit of Rs. 1,400 was realised. Broach cotton sold amounted to 864 Nagas (1 Naga is equal to 1,344 lbs.), worth Rs. 1,50,180, or an increase of about Rs. 40,000 over last year's figure. 137 Nagas of Cambodia cotton worth Rs. 24,730, were received. The following table drawn up by the Divisional Inspector of Agriculture Southern Division, is worthy of study. It shows the history of cotton since its introduction and the benefit derived by the cultivator, which amounts on the average of five years to Rs. 9 per acre, per year, in excess over Kumpta :—

Serial No.	Years.	Broach Cotton sold in the auction sale Nagas.	Probable area to grow the cotton in acres.	Rates on the dates of auction sale for			Actual total amount realised by the sale of Broach cotton.	Amounts for the same quantity of cotton at the rates for the local variety.	Amount of extra profit to the growers.
				Highest grade of Broach.	Lowest grade of Broach.	Local Kumpta.			
			Acres.				Rs.	Rs.	Rs.
1	1910 ...	694	2,616	190	163	145	1,11,455	94,830	16,625
2	1911 ...	171	684	220	191	153	37,069	26,163	10,906
3	1912 ...	430	1,720	203	173	146	81,545	75,680	5,865
4	1913 ...	595	2,380	200	161	138	1,09,393	82,110	27,283
5	1914 ...	865	3,460	190	155	129	1,50,180	1,09,585	40,595
Total...	...	...	10,360	...	...	...	4,89,642	3,88,368	1,01,274

N. B.—Yields are calculated at 336 lbs. per acre.

A considerable quantity of Broach cotton was marketed at a later date independently of the Department.

The seed supply of these cottons was obtained as usual by buying back the seed from the special and 1st classes. In the case of Broach cotton, this source was supplemented by an importation of 10,000 lbs. Navsari seed. Central depôts were opened at Gadag and at Dhárwár, and sub-depôts at the Dhárwár Farm, Garag, Aminbhavi, Shiggaon, Bankapur, Ranebennur, Hubli, Gadag, Ron, Sudi, Gokák Canal Farm and Hukeri. Besides cotton, groundnut and potatoes were distributed from such of these depôts as were suitably situated.

JOWAR.

Many varieties have at one time or another been grown on the Dhárwár Farm. It is now almost definitely proved that the local Fulgar Yellow is the most suitable variety—others head the list in exceptional years, but Fulgar Yellow retains a relatively high place throughout. The question now arises as to how far the cultivator is justified in mixing his varieties, as he usually does, and an experiment with this object in view has been laid out. Its results will show whether or not we are justified in attempting to place a pure strain of any one variety on the market. The production of such a strain being the ultimate object of the selection work.

The Gadag Farm has given positive results regarding the introduction of rabi-jowar from other localities. Bhima and Maldandi from Sholápur have both done better than the local during four years. Maldandi will be tested by selected cultivators during the coming years and if found successful, will be placed on the market.

An analysis of Sholápur varieties at Barshi shows that Maldandi is the commonest all over the District except in Barshi where Dagadi forms 93 per cent. of the crop.

Steeping in copper sulphate to prevent smut seems to be becoming rapidly popular.

WHEAT.

New Bansi has been successful in Gadag and will be tried in one or two places in the district during the coming year. The progress of the selection work on the Dhárwár Farm is somewhat indefinite. Pedigrees of the various strains are printed as an appendix to the Dhárwár Farm Annual Report. A statistical study of selected and unselected individuals promises to be interesting.

GROUND-NUTS.

An experimental plot has been started at Islampur in the Sátára District. Its objects are to test the alleged deterioration of the imported variety and the supposed ill-effect of this variety on the succeeding crop.

In the Southern Mahratta country groundnut does not spread rapidly—about 3,000 lbs. were distributed during the season. It seems that uncertainty of early rains in the black soil tract and wild pig in the Mallad limit the extension of this ordinarily paying-crop.

POTATOES.

Good imported seed worth about Rs. 2,000 was distributed, largely by the Belgaum Seed Society and by the Agricultural Association, Dhárwár. An experiment in fumigating Belgaum potatoes was successful. 1,000 lbs. were bought, brought to Dhárwár and fumigated with Carbon disulphide in a closed pit. They were in good condition at sowing time.

It seems that growing potatoes round Dhárwár is not an economic proposition. Moth and wilt combine to destroy the crop. Potato culture at present can only be regarded as a pastime for those who can afford to lose by it.

SUGAR-CANE.

Manurial experiments are in progress, both on the Gokak Canal Farm and in cultivators' fields in the Sátára District. Safflower cake has this year, as a rule, done better than Ammonium Sulphate. Ammonium Sulphate was imported and distributed on a fairly large scale chiefly in the Sátára District.

OTHER CROPS.

Call for no special remarks at present.

MANURIAL EXPERIMENTS.

Those on sugarcane are mentioned above. Cactus has been shown to be useless as a manure for cotton and jowar at Dhárwár and for maize at Gokák. Cake manures at Dhárwár increase the outturn, but at excessive cost. Six years' figures show that the local practice of manuring jowar gives better results than manuring cotton in a two-year rotation.

ROTATIONAL EXPERIMENTS.

One only need be mentioned here, the two-year rotation series on the Dhárwár Farm. Our 6 years' experiences point fairly definitely to the following conclusions :—

(1) Cotton is better after jowár than after the other crops

(2) Cotton and jowár, with or without pulses, are the most profitable combination.

CULTURAL EXPERIMENTS.

The general trend of the results obtained at Dhárwár and at Gadag is to the effect that deep ploughing every year is extremely unlikely to be profitable. Experiments at both places are to be modified to include deep ploughing once during the rotation.

IMPLEMENTS.

Depôts have been established at Bársi and at Islampur. 8 C T, ploughs and 2 Sabul ploughs and 4 Planet Junior hoes have been sold from these two places. In Sátára District many cultivators purchase ploughs from Messrs. Kirloskar Brothers and many in this district and in Sholápur District order implements direct from the Poona College Farm.

In the Southern Mahratta Country implements were sold as stated below :—

Kind of implement.	Number sold.			
	Office of the Divisional Inspector.	Dhárwár Farm.	Gadag Farm.	Gokák Canal Farm.
Gallows ploughs	3	4	...	1
Shares for ploughs	...	3	...	...
C. T. 2 ploughs	10	9	...	2
Shares for ploughs	37	20	...	...
C. T. 1 plough	4	6	...	...
Shares for plough	...	...	...	...
Sabul plough	...	1	...	...
Ridging plough	...	1	...	...
Shares for B. T. 2 ploughs	...	5	...	...
Chain for ploughs	153 ft.	197 ft.	...	...
Ohio Chaff-cutter	17	1	...	1
Kirloskar's do.	...	...	...	1
Buco hand cultivators	...	3	...	...
Iron scrapers	...	1	...	...
Gul pans	21	...	...	8
Kirloskar's Cart Wheels	2	...	...	...
Spanner	...	1	...	...
Sugarcane mills	...	...	...	2
Kirloskar's ploughs	...	...	...	3
Do. Corn Sheller	...	...	...	1
Do. Hand Hoe	...	...	...	1
Gul Moulds	...	...	...	31

Implements costing in all Rs. 964-5-0 were hired out from Dhárwár, Gokák Canal Farm, Islampur, Bársi and Sholápur. Receipts totalled Rs. 153-11-0, or 16 per cent. on capital outlay.

The Bajac plough was given on hire at Rs. 35 per acre, inclusive of all charges. This barley paid expenses.

The steam plough has been reported on in detail elsewhere.

The Olpad Wheat thresher has been proved very successful, the cost of threshing 5,000 lbs. of straw being about half of that incurred when the local method is adopted.

SHOWS AND DEMONSTRATIONS.

The contributions to the Show held at Ranebennur in November and the implement demonstrations undertaken in connection therewith have already been described. Besides this, several demonstrations took place:—Gul boiling in 4 places, ploughs and implements in general at one village, ploughs in 8 villages of the Bársi táluka, Olpad Wheat thresher at 3 and Chaff Cutter at one place. In response to a request received from the Collector of Sátára, the method of preparing prickly-pear for feeding stock was shown in 12 villages of the Khatav táluka and in 9 villages of Mán.

LIVE STOCK AND MISCELLANEOUS.

The Farm at Tegur is now stocked with two stud bulls, twenty cows, 2 heifers, 7 bull-calves and 19 cow-calves. The bull-calves over six months old have been castrated. Two sheds, a small well and an ensilage pit have been constructed. The year's experience has shown that cattle become very weak if fed on dry grass only.

Ensilage made from grass in an unbuilt pit was more or less successful. A large proportion, however, became mouldy. The cattle ate it greedily, if care was taken to remove the moulded portions. A stone pit on the Gokák Canal Farm turned out excellent sillage made from maize stalks cut into about 6 inch length.

An enquiry into the conditions affecting the butter trade in villages along the Krishna Valley in Sátára District will, it is hoped, lead to the establishment of a Co-operative dairy.

T. GILBERT,

Deputy Director of Agriculture,
Southern Division.

Dhárwár, August 1914.

APPENDIX E.

SUMMARY OF THE WORK DONE UNDER THE DEPUTY DIRECTOR OF AGRICULTURE IN SIND FOR THE YEAR 1913-14.

Season.—The season from all points of view was a bad one. The noteworthy character was the unprecedented deluges in Lower Sind. At Mirpurkhas 22·17 inches of rain fell altogether mostly in July and August. The rain not only did damage by flooding and encouraging rank growth of weeds all over, but the Marwari and Desert coolies returned to the desert according to their usual custom when there is good rainfall. Consequently the abour question was very acute and hoeing and weeding cotton was very imperfectly done.

In Upper Sind the inundation was poor, and after the first flood the river suddenly dropped causing serious deficiency in the water-supply.

Present condition of Agricultural Department in Sind.—The budget of the department has been considerably increased in the last few years. The pay and travelling allowance of the staff now amounts to about Rs. 30,000 and current expenditure after deducting receipts paid into treasury also to about Rs. 30,000. These figures do not include capital expenditure on buildings, land, etc., which can be balanced by the valuation. The capital expenditure in the year owing chiefly to acquiring 200 acres of a new Seed farm was nearly Rs. 50,000. For this expenditure the Department carried on 4 Agricultural Stations, each representative of the chief agricultural tracts of Sind, the Daulatpur Alkali or Kalar reclamation station, the new Seed Farm and seven sub-stations. Besides the staff on the various farms there is a district touring staff.

Agricultural Stations.—The four farms are the foundation of the Department in Sind, without these farms in efficient working order and able to investigate the special agricultural problems in these various tracts any progress is impossible. They are :—

Mirpurkhás.
Sukkur.
Lárkhána.
Landhi.

Detailed reports are published of the work on each farm.

Mirpurkhás is chiefly engaged in cotton work and in rotations. The staff was busy this year with the work in connection with the buying and ginning agency for Sind-grown American cotton. The kharif season was very unfavourable on this farm and part of the farm was badly flooded.

Sukkur.—There was nothing of outstanding interest on this farm. Since the farm steam-engine and centrifugal pump were installed on the Indus to irrigate this farm, 4 or 5 pumping plants have been put down along the bund.

Lárkhána.—This farm completed the first year of working. The situation is particularly good as it combines some good rice land with typical dry crop land suitable for bosi cultivation. The bosi land is that irrigated in the hot weather and thereafter ploughed till a mulch is formed on the surface and a cold weather crop, generally wheat, drilled in to the wet layer beneath. Implements such as harrows give much promise as labour savers for this class of land.

Landhi.—This farm is representative of the market gardening (mainly potato cultivation) and fruit growing in a limited area round Karáchi. Over 2,000 acres of potatoes are cultivated in the tract each year. This farm also completes its first year of working.

Daulatpur Reclamation Station.—This farm of 400 acres was auctioned during the year, the work having been completed. The land was taken over in 1907 with the object of bringing into cultivation the worst class of alkali land. A complete report giving full details of figures and results has been prepared.

Seed farm.—200 acres of land were acquired in the present year, 2 miles from Mirpurkhás, for producing pure seed of American cotton and berseem (Egyptian Clover). The necessary buildings have been erected with Dutch barns for storing berseem and cotton. A Saw Gin, Power Clover Threshing Machine and a portable 6½ H. P. Oil engine have been bought.

Sub-stations.—7 sub-stations were working during the year. They consist of from 6 to 10 acres and are either taken on loan or rent from the owners, They are worked by 'haries' or tenants on the share system. Each group is under the direction of a Graduate from the Poona Agricultural College. The sub-stations were situated as follows :—

Tando Jam	...	Hyderabad District.
Tando Mahomedkhán	...	
Nawabshah	...	Nawabshah District.
Nausháhro Feroz	...	
Sháhdádpur	...	
Shikárpur	...	Sukkur District.
Jacobabad	...	Upper Sind Frontier District.

These sub-stations were used for demonstration purposes.

The *Tando Jam* and *Tando Mahomed khan* sub-stations were not outstanding. The 'haries' neglected the American cotton plots, Sindhi cotton gave 700 lbs. seed cotton per acre at Tando Jam.

Nawabshah produced about 400 lbs. American cotton per acre and Nausháhro 300 lbs. per acre. At Shádhádpur American cotton was a failure. At *Sháhdádpur* 1,236 lbs. seed cotton per acre from selected Bhitshah seed was produced.

In all the Lower Sind sub-stations the Upper Sind jowárs 'Alak' and 'Red' seem to be superior to any of the local varieties 840 lbs. and 684 lbs. grain per acre were obtained at Sháhdádpur. The latter also gave 900 lbs. to an acre of bajri grain. Tur and other pulses gave saitsfactory growth at most sub-stations.

At Shikárpur even with the shortage of water the American cotton yielded a fair crop. The average of American 'Triumph' was about 5 maunds per acre (of 80 lbs). The Sindhi gave about the same yield.

One acre of red jowár gave 13 maunds 18 seers grain.

Jacobabad.—The yield of American cotton was about the same as at Shikárpur. The Sindhi cotton was over 6 maunds.

District Work.—Three Graduates toured regularly in the cold weather visiting zemindars in their divisions, also the Divisional Inspector of Agriculture was on tour, and the various Farm Superintendents in the neighbourhood of their farms. They held lectures in the villages, showed seeds and ploughs and booked orders for American cotton, etc. In the hot weather they held demonstrations on the sub-stations and visited growers of American cotton. The Graduate in Upper Sind was engaged practically all his time in distributing American cotton seed and giving instructions as to its growing. The Nawábshah Graduate reports as to visiting 30 leading villages in his district and the Lower Sind Graduate to holding 25 villages demonstrations.

Cotton.

American cotton operations.—A Bombay Syndicate arranged to erect 2 gins in Sind, one at Shikárpur and one at Mirpurkhás, to buy American cotton grown from seed distributed by the Department, and to market the produce. Seed was got from America, 'Triumph' variety, 10 tons were distributed in Upper Sind Frontier and 30 tons round Mirpurkhás on the Jamrao. Cotton is not grown in Upper Sind by the cultivators and they require a considerable amount of teaching as to its proper cultivation. As the inundation was late very little of the seed was sown and the gin at Shikárpur was not opened. Any American cotton brought in was sent to Mirpurkhás. This gin produced 511 bales and about 20 bales of stained cotton. It was ginned in a somewhat dirty state and was sold under Liverpool grading at 1 to 1½*d.* per lb. under Middling American. It is hoped that the grade will eventually reach Mid-American.

For the coming season indents were booked by the staff and the following quantities of seed were distributed :—

District where distributed.	Maunds(lbs.)
Thar and Párkar	1,103
Hyderabad	26
Nawabshah	115
Karáchi	12
Upper Sind Frontier and Sukkur ...	162
Lárkhána	114
Total ...	1,532

9 bales of special stapled cotton grown on Daulatpur Farm were ginned separately and shipped to Liverpool. It was graded as Middling American and reported on as follows :—

Report by Messrs. Greaves Cotton & Co.

"Our Manchester friends write us as follows :—

"We have now seen samples of J. G. & Co., Liverpool, 9 bales *Ex* 'City of Paris', and find them about the same grade as the type "Allens", but the staple more mixed and hardly so strong, and we should not care to value them at more than 7·50*d.* nominal. We should be glad to know at what price you would be willing to sell . . . . . ". The rest of the district American cotton was valued at about 6 to 6·50*d.*

Hot Weather Cereals.

These call for little remark. In Jowárs, the 3 Presidency varieties which have been tried for a number of years have been given up for an Upper Sind white Jowár "Alak" and an Upper Sind red Jowár. The grain of the 2 latter is not so good, but they are freer growers and very quick maturing plants.

Wheats.

Selected soft white Sindhi is the heaviest yielder at present. The only typical wheat soil is that of the Lárkhána farm where wheat is grown as 'bosi,' *i. e.*, land is only watered in the hot weather. One plot of bosi wheat at Lárkhána gave over 20 bushels to the acre without any further waterings in the cold weather.

Fodder Corps.

Berseem has proved itself in all parts of Sind as by far the best crop both for yielding high class nutritious folder and also the best rotation crop for keeping up the fertility of the land. It can only be cultivated where water is available in the cold weather. All classes of live-stock thrive on it and horses and cattle can be tethered on it for 6 months in the year. A trial truck load of berseem hay was sent from Thar and Párkar district to Bombay. It is to be tried for feeding race horses against Australian Clover Hay. Requests for seed are coming in from all over India. With the new Seed Farm in operation, the Department will be in a position to supply more seed.

For hot weather fodders a number of pulses are being tried on each farm. The best pulses are different for each class of land. In the light soil of Karáchi, Guar seems one of the best, in other places Val, Chowla and velvet bean are the most promising. Pulses of all sorts should be more generally cultivated in Sind. The number of crops in general cultivation is extraodinarily small.

Miscellaneous.

The minor crops experimented with are all mentioned in detail in the various farm reports. Rice tests are being conducted in Lárkhána. Potato rotations are being experimented with at Landhi. Here the potato-groundnut rotation seems to give promise. Groundnut is quite a new crop for Sind.

In the present season potato seed was successfully stored in the farm godown at Landhi in shallow wood spar boxes. These can be built up in layers up to roof and the potatoes sprout in the boxes. They are planted direct from the boxes without handling and the sprout is unbroken. The potatoes are easily inspected and diseased ones removed. The boxes were filled in February and the seed planted in June, little loss occurred in the 4 months. Storing in sand was found to be useless.

Fungoid and Insect Pests.

These were as usual but no serious loss occurred on any of the Farms.

Garden and Vegetable.

Small area of suitable fruit trees are growing on all the farm, with larger area at Landhi. Grapes and oranges are the most promising.

Vernacular Agricultural School.

The first 8 students passed out of the School in October and 9 new students were enrolled for present session. The course is as practical as possible and lasts for 12 months. The instruction is in Sindhi. Of the students passed out—

2 are employed by Zemindárs

3 are working on their own lands

1 is working as a Tapedár

2 are shortly expecting posts as Kámdárs for Zemindárs.

The present lot are between 18 and 20 years age and are able to read and write Sindhi They come from the following districts :—

Thar and Párkar	...	...	...	2
Nawábsháh	...	...	...	2
Hyderabad	...	...	...	1
Lárkhána	...	...	...	2
Sukkur	...	...	...	1

Seed Distribution.

The seed distribution is now reaching large proportions especially from Mirpurkhás. The lists for each farm are given in the reports.

Implements.

The general Implements recommended are :—

	Rs.
Egyptian wooden plough at	5
Scraper for levelling land at	7
Norag or Threshing machine at	40
Winowing Machine at	165
Reaping Machine at (Wallace's "Narbuddá") ...	255

The special implements recommended are :—

		Rs.
Water Lifts ...	Dutch wheel water-lift for small lifts at	465
	Archimedian screw water-lift do.	600
	Noria water-lift up to 10 feet lift at	375
Spring toothed harrow at		39
Clod Crusher at		150
Hosier Seed Drill at		375

Egyptian plough is now being made by many local mistries. An improvement has been made by substituting the present sort iron share for a case hardened steel one. 1,000 shares have been imported and are being sold to local makers. It will lengthen the life of the plough considerably and will considerably add to its efficiency.

Live stock.

The Superintendent Civil Veterinary Department selected with considerable difficulty 1 bull calf and 3 heifers of the best Karáchi milch cattle. Their dams are known and their milk records have been taken. The yearlings are being fed on a government farm. It will afford a good test of what the Karáchi cattle are capable of. As a rule, the young cattle are much neglected and underfed and only when they do produce milk the owners try to feed them well. It is also said that the milk yield of Karáchi milch cattle always drops and is permanently decreased by change of environment on leaving Sind.

Half a dozen good 'dumba' sheep are being kept on Lárkhána Farm as a nucleus of a breeding flock.

A few hens are being kept on all farms, Indian game and Persian Gulf fowls.

Shows.

During the year Agricultural shows were held at Sukkur, Lárkhána and Mirpurkhás Various classes, arranged for zemindárs' produce suitable to the different districts, were included At the same time lectures and demonstrations were held, and in each case exhibits of produce, etc., from the various Government farms were on show.

APPENDIX F.

SUMMARY OF WORK DONE UNDER THE PROFESSOR OF AGRICULTURE, 1913-14.

THE AGRICULTURAL COLLEGE FARM, POONA.

I.—Practical Work of Agricultural College Students.

This is the main function of the Farm, and as such, all possible attention is devoted to lay out the work of the farm in such a way as will afford the best facilities to make the practical work in the branch of Agriculture as efficient as possible. The practical work is so arranged that each student individually receives attention of the teacher.

II.—Experimental and Research Work.

In the area worked by the senior students of the College some experiments of a permanent nature are laid out to demontrate and teach to the students the methods of experimentation, and few other experiments are also carried out by the farm in the area not occupied by students' work. Such of these, as have yielded useful and instructive results during the year under report, are summarised below crop by crop :—

Cotton.

Profits from the cultivation of *neglectum* types of cotton on an average of four acres with the best of the cultivation amounted to Rs. 28-3-0 at a cost of cultivation of Rs. 29-12-0. The seed cotton in calculating the above has been valued at 12 lbs. per rupee.

Plant to plant selection of Cotton.—As a result of four years' selection the outturn per plant has increased from 25 to 50 per cent. or more, as compared with the outturn obtained per plant to start with.

Manurial requirements of Cotton :—A complete manure consisting of sulphate of ammonia sulphate of potash, and superphosphates in addition to 5 cart-loads of farmyard manure per acre supplemented by lime has given the largest yield in both the duplicates ; it however does not pay to apply artificials to cotton. The five cart-loads per acre is the only plot which has left any profit by the addition of manure.

Cotton varieties suitable to the tracts similar to Poona.—Among *neglectums* Cutchica has again topped the list in point of net amount of money returns ; next is *Roseum.*

Amongst the superior varieties Broach has not done well as was expected owing very largely to the want of Rabi rains.

Amongst *Hirsutum* types Bhuri has given an outturn of 768 lbs. per acre, and stands second to neglectum types of cotton in point of money return. Cambodia persistently shows unsuitability to the climatic conditions existing in Poona.

Jowár.

Poona seems admirably suited to kharif jowárs on better classes of soils. The average net profit from this crop from an aggregate area of four acres is Rs. 67 per acre at a cost of cultivation of Rs. 47. The rates at which the grain and fodder are valued are 30 and 150 lbs. per rupee respectively. The varieties grown were *Perio* from Surat, *Gudghi* from Dhulia, *Gidgap* from Sátára, and *Fulgar Yellow* from Dhárwár.

The cultural experiments carried with rabi jowár have given considerable advantage. An 18″ distance between rows with half the usual seed-rate and superior intertillage have all proved more profitable in point of grain than 9″ distance and no interculturing respectively.

Amongst the kharif varieties tried, *Gudghi* in point of grain and *perio* in point of fodder have stood first, the latter being next in rank in point of grain also. *Gudgi* is however early while *perio* is late.

Groundnut.

It is thoroughly established by repeated trials that the local varieties of groundnut cannot stand competition with the introduced foreign varieties on any point, *viz.*, yield, resistence to disease or moisture requirements.

In the several varieties under trial, Pondichery has again been the highest yielder amongst the late spreading varieties and Spanish peanut amongst the early ripening erect varieties. The big erect has yielded nearly as much as Pondichery and shows good promise.

For smaller varieties like Spanish peanut and small Japan, it is again and again confirmed that a distance of 6″ × 4″ is better than 9″ × 6″. (This experiment was originally laid down by me, *i. e.*, Mr. P. C. Patil, and is since then continued).

In point of manurial requirements, the addition of nitrogen in the form of ammonium sulphate has actually decreased the outturn, and replacing half the quantity of farmyard manure by potash alone in the mineral form has caused a decrease in the yield of nuts though there is slight increase in the stalks. In another experiment it is shown that though the

various elements of plant food in mineral forms enhance the outturns more or less, still five cart-loads of farmyard manure is the most profitable.

The Spanish peanut, owing to its earliness and belonging to papilionaceous order, has shown a decided advantage for being grown as subordinate crop in Broach cotton. This method of mixture has given a net profit of Rs. 42 while cotton and til mixture with which the former was compound gave only Rs. 21.

Bajri.

The net profits from this crop during the year under report amounted to Rs. 27-12-0 per acre with a cost of cultivation amounting to nearly the above figure on an area of 5 acres, which is similar to the soils allotted to Bájri in the neighbourhood, which has not received any manure for the last two years, but the good results obtained are due chiefly to better methods of tillage, including deep ploughing after the previous crop is off, keeping the land clean of weeds and preservation of water to the benefit of the crop. Bájri grain has been valued at 25 lbs. and straw and chaff at 200 lbs. per rupee.

Potato.

This crop was a total failure in all the plots on this farm due to the fungoid disease *Rhizoctonia Solanii.* As a result the crop produced only one-fifth of the normal, or even less. This disease was as bad in plots which had no potato crop on it for the last eight years, nor were in any way nearer to an infected plot so as to have caught the infection from the latter. A big plot of a cultivator near Kirkee who had grown this crop for the first time met with the same result.

An experiment was carried out by Mr. Ramrao, Lecturer in Entomology, in storing potatoes; and the results show that the method of storing on racks, in a room having good ventilation but not allowing any access to moths, is the best. The loss only amounted to three per cent. The diseased potatoes have to be sorted out before storage and the quantity to be stored fumigated in an airtight resorvoir by petrol. The fumigation has to be repeated once or twice again if any caterpillars are seen which might have hatched from the eggs at the time of storing and which were not killed in the process of first fumigation.

Turmeric.

Replacing 15 cart-loads out of 30 cart-loads of farmyard manure by 1,200 lbs. of safflower cake, has increased the outturn by about 16 per cent., while replacing half the quantity of safflower cake in the above by ammonium sulphate supplying equal quantity of nitrogen has not shown any benefit.

Sweet potatoes.

Replacing 15 cart-loads out of 30 of farmyard manure per acre usually given to this crop, by 1,200 lbs. safflower cake, has increased the outturn by 35 per cent., while substituting half the quantity of safflower cake by ammonium sulphate supplying the same quantity of nitrogen has further increased the outturn by 43 per cent., having a net profit of Rs. 40 and 70 respectively over the full quantity of farmyard manure.

Gram.

The brown seeded variety has proved even this year earlier by about one month and a better yielder by about 75 per cent. than the black seeded. These results are in confirmation of those obtained during the last year. This fact brings out the necessity of not allowing the black seeds to mix with the superior brown variety.

Linseed.

Greater distance between the rows in this crop does not seem advantageous as a 9″ distance gave nearly double the outturn of 18″ distance even in a year in which there were practically no rabi rains.

Onions.

This year again nitrogen in the form of nitrate of soda has proved superior to the same quantity in the form of sulphate of ammonia, and the average net increase of the two duplicates is about 40 per cent. which more than makes up the extra cost of Nitrogen in the form of nitrate of soda.

Rabi Jowár.

Wider distance between rows so as to admit of interculture, less seed rate and good interculture, which are principles of dry farming, have all shown an advantage during the last year in which there were no rabi rains, and the crop had to sustain itself on the moisture from kharif rains. The greatest benefit was however shown by good tillage, which amounted to about 37 per cent. and yielded a net profit of Rs. 20 with an additional cost of Rs. 3 only.

Cabbage and Knolkhol mixture.

Replacing 24 out of 48 cart-loads of farmyard manure by 6 cwts. of nitrate of soda, has increased the outturn which is however just enough to pay the extra cost for nitrate of soda, when the rate of farmyard manure is Rs. 2 per cart (800) lbs.

Wheat.

Green manure of san has given less outturn of grain and more straw than 10 loads of farmyard manure per acre. The cost of green manuring is however less by Rs. 5 to Rs. 6 than the cost of 10 loads of manure at the rate of Rs. 2 per cart. So the net profit from San green manuring is only short by Rs. 4 as compared to the farmyard manure. It was first intended to take the crop on soil moisture alone, but when it was found that this was not possible owing to want of rabi rains irrigation was given.

San and Nigerseed were also compared as a green manurial treatment for dry wheat (Shet Parner). The results are in favour of nigerseed by 27 per cent. in the case of grain and about 50 per cent. in the case of straw. The plot of nigerseed was also better than fallow by about 10 per cent. in the grain and cent per cent. in the straw. The comparison between San and fallow shows a drop of 13 per cent. on the grain but a gain of 44 per cent. in the fodder. In order to secure the maximum advantage of green manuring the crop must be turned in early so that subsequent rains fill in the bed made porous, by the addition of humus.

Tobacco.

500 lbs. of sulphate of ammonia, in addition to phosphoric acid in form of dissolved bones, and 24 cart loads of farm manure have increased the outturn over the last two by only about 12 per cent. which is nearly as much as to pay for the extra cost of ammonium sulphate. When the nitrogen as above replaces 24 out of 48 carts of manure nearly the same results are obtained.

Phosphoric acid in form of 200 lbs. of disolved bones, in addition to 24 cart loads of manure and 256 lbs. of muriate of potash, has similarly increased the outturn over the last two only by about 12 per cent. so as to pay its own way.

A complete manure in the form of minerals consisting of 256 lbs. muriate of potash, 500 lbs. of sulphate of ammonia and 200 lbs. of dissolved bones to replace 24 out of 48 cart loads of manure has increased the outturn over the full farmyard manure plot by 25 per cent; but as the outturn of both the plots is low owing to water-logged conditions and consequent late planting, the increase has not been able to pay the additional cost, due to minerals.

Lucerne.

The bed system of cultivation of this crop has given more yield than the ridge system, unlike the first two years. This is due to the small and narrow ridges closer together. As years go on root stock increases and the gradual washing of the side earth by irrigation water exposes the roots which die out by drying and wilting and weaken the plants. Economical repairing of ridges is not possible if the ridges are too close to admit of any ridger being used. This indicates that broader ridges, sufficiently wide apart to admit of interculture and repairing damaged ridges by implements, should be made.

New crops.

Burbank's spineless cactus is on this farm for the last three years but it has not grown to more than four leaves. It may be therefore laid down that this is not likely to succeed in the Deccan.

Farm Irrigation.

Management and control of field distributaries for irrigation is an important item in the methods of irrigation. When water is to be led in channels which are sloping, a considerable erosion take place and the bottoms of the channels go deeper and deeper making it very difficult to take side outlets. Such channels are also overgrown with water grasses, rushes and deep rooted weeds like *lavala* and *hariali*. The former choke up the water channels, while the latter shed their seeds in the running water which become a fruitful source of these weeds in the field.

A devise has been designed by Mr. Gokhale, Superintendent of the College farm, which consists in fixing cheeks of galvanised iron sheets at intervals according to the slope, so that the channel appears like terraces with sharp waterfalls at the checks. The force of the falling water is checked by a gutter, about 1 foot long, fixed at the back end of the check and as much below as the fall between the ground levels of this and the next check below. This has been found to be very effective in controlling the erosion.

If guinea grass be planted on both the sides of the water channel the erosion is considerably prevented. It is found that when guinea grass is once established its root system does not allow any other weeds to take hold. The crop moreover yields a very succulent and nutricious

fodder at the rate of nearly 400 lbs. of green fodder per year per 100 feet length and which is worth Rs. 2. The system is followed on this and Manjri farms, and is being followed by neighbouring farmers.

Farm Implements.

Ploughs.—Ransome's 'sabul' plough has been found very good for light ploughing. It is a land-side plough and has a very good turning mould-board and a bar-share-point, which is long enough to be used for several years, as the worn out point can be sharpened and the bar thrust a little forward, when necessary, to give the required projection. It can be drawn by one good pair. The penetrating power of the plough can be adjusted by pushing the bar point backward or forward.

The *National Sulky* reversible is another plough which is also found efficient for the class of work nearly approaching Ransome's S. A. E. Gallow's plough. The advantage of the former over the latter is in that it is reversible, not sacrificing at the same time any of the advantages of the land side. The shape of the mould board is better suited to turn the soil than any other plough tried so far. Moreover it is a riding plough and saves the trouble of walking for the ploughman. This can be worked by three good pairs or four ordinary pairs of bullocks. It costs Rs. 180; but in fact two ploughs are obtained for this sum, out of which only one works at a time; so the life period of the plough may be safely taken at double that of the ordinary plough.

For dealing with hard baked land in summer the Cockshutt plough was found superior to S. A. E. Gallows.

Rudsack's S. P. 10 plough, which is a land-side one, is found more efficient and less costly than Ransome's C. T. ploughs. Similarly *Arlington No. 30* which does as deep or perhaps deeper work than Ransome's C. T. and is as strong was found to require slightly less draft, and is cheaper than the latter by about Rs. 5.

Harrows.—Disk harrow has been found very advantageous in breaking the surface of the soil immediately after a crop is taken off. This operation conserves whatever moisture is left in the ground and facilitates ploughing at leisure; or one or two more turns of the Disk prepares the land for seed bed where no ploughing is resorted to. One more use for the disk harrow was discovered, namely, as a threshing machine for wheat, bajri, jowar and the like for which Norag thresher is recommended.

Seed-drills.—Clipper drill continued to prove quite satisfactory for sowing almost all crops except cotton and groundnut.

Considerable amount of work was put in by Professor Knight in developing the ideas about improved yokes adapting the country cart for dumping the contents without unyoking the bullocks. Every pair has got its own yoke. The yoke goes with the pair to any implement. These yokes are provided with rings on which the poles of the implements are fixed.

Professor Knight has further tried to replace the elaborate system of roping in the country plough by means of few rings and clasps.

III.—Dissemination of Agricultural knowledge and Improvement and General Aid to the Agricultural Public.

In addition to the main functions of education to the College students, conduct of experiments and investigation work alongside of it, this farm, as a central and headquarter Agricultural Station, is also called upon to do the equally valuable work of educating the agricultural public. With this view various activities were undertaken during the year under report.

Demonstrations of better methods of farming.—The farm is always on show, and a collection of almost all the agricultural implements, machinery and appliances that the Department recommends is always on view, any of which are shown in actual work if required by enquirers.

Special demonstrations were arranged in connection with the Provincial Agricultural Conference in September, when the members and the visitors saw on the College farm a number of demonstrations; a similar demonstration was conducted on the farm for the Agriculturists of Poona, Satara and Sholápur districts under an officer specially deputed for the purpose. Intelligent cultivators from these districts were invited, about 50 or more from each táluka visiting the farm every day. The demonstrations lasted over a period of one month and in all 2,249 cultivators saw the demonstration.

Assistance was given to the various exhibitions, demonstrations and shows held in the districts by the Department or the Deccan Agricultural Association by supplying exhibits and implements, and in some cases members from the farm staff were sent to deliver lectures and to conduct the demonstrations.

Considerable amount of work of imparting agricultural knowledge was done by correspondence. In all 519 inquiries were dealt with during the year under report, the majority of which were in vernacular.

Seed, manure and Implement Depôt.—While demonstrations are very successful in bringing home to the cultivators the agricultural improvements and the use of labour-saving appliances, they are in no way enough to bring about the adoption of the improved appliances. If they are only referred to the various firms dealing in them, the cultivators do not go to the trouble of getting them direct from these firms, most of whom have their business carried in English, and do not either supply retail quantities at all or charge large prices. They want some place in their neighbourhood where they can communicate personally or by correspondence in vernacular as to their requirements and get small quantities at reasonable terms. For this purpose they seem to have more confidence in the institutions of this Department.

In order to fill this want, a depôt of implements, manure and seed is kept on this farm for the last six years and every year it is becoming more popular. The depôt carries a stock of approved goods of the various firms. During the year under report implements worth Rs. 21,000 consisting of Ransome's and Arlington ploughs, Planet Junior hand hoes, plough chains, scrapers (leveller) manure worth Rs. 5,000 consisting of sulphate of ammonia and small quantities of sulphate of potash, and super phosphate, and 12,000 lbs. of seeds consisting of guinea grass, fodder jowars, lucerne, groundnut, etc., were sold.

IV.—Investigation Work by other Members of the College Staff.

In addition to the above main activities the farm also afforded facilities to the members of the College Staff in carrying out their respective investigation work by either providing ordinary or skilled labour, land and materials and expert supervision as much as practicable.

MANJARI FARM.

Sugarcane.

I.—Rotation Experiments.

These have in the year under report definitely proved the superiority of Sann as a green manure to sugarcane crop, over the usual application of farmyard manure. Even when only 10 cart-loads farmyard manure ($\frac{1}{3}$ the usual application) was given in addition to Sann green manure the outturn of Gul per acre was nearly 2 tons greater than when a full quantity of farmyard manure was given. Sann green manuring costs Rs. 18 and the additional Farmyard manure costs 20. The value of the increased gul comes to about Rs. 254; or we get a net gain of Rs. 276, if we take into consideration the saving of $\frac{2}{3}$ the farmyard manure the cost of which comes to about Rs. 40. But deducting Rs. 60, the net profit of growing fodder in the previous year, we get Rs. 216 per acre as the net profit of Sann green manuring over growing a fodder crop during the previous year. It is to be seen next year whether Sann green manure cannot be entirely depended upon for furnishing the coarse manure.

Fallowing has given 4,800 lbs. more gul worth Rs. 300 at a cost of only Rs. 9 per acre. Deducting Rs. 60, the net profit of growing fodder, we get a clear profit of Rs. 240 over growing fodder. The experiments were carried out for the last six years. From the next year they will be given up finally.

II.—Manuring.

(*a*) *K. P. N. Experiments*—These experiments are conducted for many years on this farm and the results are not promising in any way. There does not seem any advantage in adding extra amount of potash and phosphoric acid to these lands.

(*b*) *Mineral manures as a source of nitrogen.*—Nitrate of lime, a new manure in the market, has also been tried along with the old series of manures. The results clearly prove that a combination of mineral manure ammonium sulphate and some oil cake, such as Safflower cake, is better for sugarcane in these lands. Nitrate of Lime has given more yield than ammonium sulphate and will prove to be an economic manure provided it is got cheapest. Crude Nitre owing to its prohibitive cost is out of question. Nitrate of soda and ammonium sulphate have given nearly equal outturns, but at present it cannot be said which is superior of the two.

(*c*) *Cakes of different kinds.*—This clearly demonstrated the value of safflower cake over other cakes both as regards cheapness and outturn. Cotton seed cake, a new cake, is proved to be in no way superior to safflower cake and it is also dearer.

(*d*) *Safflower Ghani Cake* versus *Safflower Steam-pressed Cake.*—There is a great prejudice among the sugarcane growers against the use of safflower mill cake. They even prefer castor mill-pressed to safflower *ghani* even when the latter is rich in nitrogen and is obtained cheaper. The results in the year under report show that the country *ghani* cake is in no way superior to mill-pressed cake, in fact the latter has produced slightly more sucrose. It is always the experience that mill-pressed safflower cake is obtained cheaper in this valley, and these results will prove to be of immense value to the cultivators.

(*e*) *Concentrated manures other than cake.*—Hyma (blood refuse) which is principally exported has given again good results. It is one of the cheapest sources of nitrogen for sugarcane.

(*f*) *Pachat or Trash Manure.*—The results of this year have further emphasized the value of trash or dried leaves of sugarcane (*pachat*). It is worth noting that though the trash supplied contains only about 40 lbs. of nitrogen per acre, it is giving equal outturns of gul with farm yard manure. The question of physical condition of the soil seems to be of utmost importance in the irrigated tract. It has been found that by the use of improved furnaces sufficient pachat could be saved to serve as a manure for next year's cane practically free of cost.

The following statement will show at a glance the results of pachat plots compared with farmyard manure for the last three years :—

Treatment of the plots per acre.		Gul outturns in lbs. per acre.		
Before planting.	After planting.	1911-12.	1912-13.	1913-14.
F. Y. Manure about 20,000 lbs. containing 200 lbs. N.	Common top dressing of safflower cake and ammonium sulphate containing 150 lbs. N. in all.	8,480	,732	9,72 ?
Pachat (Trash) 10,000 lbs. containing 40 lbs. N.		8,164	7,746	10,080

The pachat was buried as it came from the field, and was not rotton before. It rots within one month.

The after-effects of the pachat manure were found very surprising. The ratoon was even, and the best of all the plots. Even the nilwa fodder taken on the pachat plot was found to give more outturn.

III.—New method of Planting.

The usual Poona method of planting consists in planting sets at 2′—2½′ apart, in furrow with beds made for convenience of irrigation. In this system the operations of weeding and earthing up are solely done by manual labour which is becoming scarce and dearer in this valley. Again the cane cultivators on canals experience difficulties in getting water at regular intervals. To face the above difficulties, cane was planted at 4 feet apart in furrows. The advantages which were found in this system were conservation of moisture and removal of weeds by interculturing by bullocks and earthing up by means of bullock implements. Thus a considerable saving in labour could be made and as more space was allowed to the cane crop, tillers were numerous and good sound canes were obtained. The outturn of gul came to 8,300 lbs., *i. e.*, slightly less than the average, but considering the economy in cultivation it is found to pay very well.

IV.—Quality Experiments.

It was found that the juice of cane from plots manured with artificial manures contained more mineral matter which has a great effect in inverting the sucrose (cane sugar) during boiling. The belief that the quality of gul depends on the kind of manure supplied does not seem to be true.

V.—Cane varieties.

Since the year 1909 some foreign varieties including seedling ones from Samalkota farm, Madras, have been grown, and some of them are found to be very promising. Pundia cane contains about 15 per cent. sucrose, while Java seedling No. 36 has been found to give 15·3 per cent. sucrose during the year under report. It was also found that striped Mauritius, Green-sports and Red-sports, ripen within 10 months from planting and they seem to be very useful for the tracts where irrigation water is available for 10 months only. The green Mauritius and red Mauritius have not been found to improve in their composition as yet. Perhaps they require more than 12 months to ripen. Next year a study in this line will be taken in hand by keeping small plots of these canes upto 18 months and analysing them every fortnight after 10 months' growth.

VI.—Crushing.

During the year under report the power crusher was tested from time to time, and it was found that the maximum capacity of extraction of a three-roller-power crusher from a soft cane (containing 10·5 per cent. fibre) is from 75 to 77 per cent., the average of the season being

73 per cent. There is considerable gain in outturn amounting to about Rs. 10 for every additional per cent. of juice from cane. Taking 67 per cent. to be good extraction on the ordinary bullock mills and that of power crusher to be 73 per cent., the gain comes to Rs. 60 per acre. During the season 30 acres of cane, including outside cane, was crushed on the crusher within a period of four months.

VII.—Furnaces.

Multiple furnace which is in fact the triple furnace (designed by Mr. Patil) with an xtra store to adapt it for power crusher was found to be very useful. It was worked for two months. It saved time and fuel (Professor Knight's report 1911-12). It was found that about half the quantity of trash per acre could be saved which is sufficient to replace the bulky manure for next year's cane. 20 pans could be boiled in 19 hours while the Poona furnaces require nearly three hours for each pan. Much care is required in managing the juice flow in the second storage pan so as not to disturb the rising scum by the addition of fresh juice; and scum should be removed as soon as it rises to the surface. If this is not done regularly, the quality of gul is likely to be spoiled.

VIII.—Cultivation.

The S. A. E. and S. E. Gallows ploughs continued to give thorough satisfaction in ploughing land for sugarcane. Only one ploughing with either of these ploughs has been found to be sufficient for sugarcane cultivation. The soil can be easily reduced further by Orwell cultivator and Disc harrow. The ploughing for sugarcane which, according to cultivator's method, costs Rs. 25 per acre can be easily done by the use of the above implements within Rs. 10.

The ridging plough of Ransome's, costing Rs. 50, was obtained this year. This has been found to be superior to all other implements for making furrows. It can be easily worked by two bullocks. The implement balances well while working. It has been provided with a marker to mark subsequent furrows.

IX.—Demonstration.

A grand demonstration was arranged for the Delegates of the Agricultural Conference held at Poona in September last. Improved methods of planting, gul making, improved furnaces and useful implements in cane cultivation were demonstrated.

X.—Education.

This farm was freely made use of in giving practical training in gul making to the students of the Poona Agricultural College and of the Vernacular Agricultural School, Loni. The usual Vernacular class in Sugarcane cultivation and gul-making was held in January.

XI.—Supply of trained hands and cane sets.

This farm distributes cane sets. It also supplied a number of trained *gulvas* to the general public. About 27 gulvas and 18 jalvas were supplied in the Deccan and the Karnatic.

Orders for Sugarcane mills, boiling pans and sachharometers are executed.

Groundnut.

Early Varieties (small Japan and Spanish peanut) have been found to be very suitable as rotation crop with sugarcane as they are ready soon, thus allowing the preparation of sugarcane land early. Late varieties delay the sugarcane planting and require more labour for their harvest. Spanish peanut has yielded up to 3,000 lbs. of dry pods.

Wheat.

Australians 22 and 27 (both awnless varieties) were grown on a large scale. They escaped the attack of rust as they ripened early. They have yielded upto 1,800 lbs. per acre. These varieties will be very suitable in irrigated tracts where rust is expected every year about the end of December.

Lucerne.

Two-year-old lucerne planted on ridges has yielded upto 48,000 lbs. of green fodder per acre.

Cotton.

An attempt to grow some varieties of cotton on irrigation was made. Sind (local), which is grown largely under irrigation in Sind, and which has been found to be superior to all varieties there, was tried. Though the crop was sown at 3′ apart, it has given promising results. It has yielded 880 lbs. of seed cotton per acre. It will be sown broadcast next year as they

do in Sind or sown 18" apart. *Cambodia,* which is found to be a successful variety under irrigation in the Madras presidency, was also tried at the suggestion of the Imperial Cotton Specialist. The crop was very vigorous but suffered much from boll worms. The percentage of lint was found to be 40·3. It was valued at Rs. 265 per khandi of 784 lbs. when Broach was Rs. 285 per khandi. Further trial will be taken next year.

Potatoes.

This crop suffered much from Rhizoctonia.

Onions.

Bed system has yielded up to 25,000 lbs. of bulbs per acre. They were heavy, medium sized, unsplit, and were valued highly in the bazár.

Chillies and Brinjals.

The solanaceous crops suffered from the curling of leaves, like last year. It has been decided not to grow these crops for some years on Manjri farm.

Scientific Work.

A special grant of Rs. 3,000 was given by Government of India for the purchase of apparatus in connection with the cane selection experiments. A complete set of apparatus has now been procured. Besides the analysis in the experimental plots on the farm, following work is being done:—

(i) A study of the Adsali (18 months crop) cane is being undertaken with a view to find out the increase and decrease of sucrose and invert sugar by analysing the canes every week.

(ii) Effect of planting at different times on ripeness. Small plots are being planted every fortnight throughout the year; analysis of these will be made after the cane is 10 months old till it is perfectly ripe.

(iii) A collection of all Bombay sugarcane varieties has been made and they are grown on the farm with a view to classify them and determine their botanical and chemical characters.

Reduction in the number of sets per acre.

The ordinary way of planting sets has been found to affect the germination to a great extent. The buds on the under surface of the sets are generally suppressed in sticky soils. It has been observed that when the sets are planted with buds on sides full and even germination is ensured. The percentage of germination by proper planting over the ordinary method has been found to be 35 per cent. more. The cost of sets can thus be reduced by 35 per cent. or from Rs. 60 to Rs. 40 by simply taking proper care in planting.

Silage for Sugarcane tops.

When power crusher is used for crushing cane, nearly all the tops are saved. These, if allowed to dry in sun, lose much of their feeding value. Attempt to put these in silo was made. The silage was taken out after two months. The cattle were found to eat with relish. It was as good as the jowar silage.

Miscellaneous.

The Hadpasar Implement Depôt was managed by the farm. There were many demands for iron ploughs and few for levellers. The disc harrow and the reaper were not used except by one cultivator. The hire for ploughs kept at Hadapasar for five months (November to March) came to Rs. 73-5-0.

Dairy and Dairy Farm.

Rearing Calves on separated Milk.—During the year 1912-13, a considerable number of calves were reared on separated milk and linseed. These calves are at present quite equal, or even superior, to those of the same age which were allowed to suck their mothers.

The procedure was as follows:—The calves were removed from their mothers at birth and taken quite away to separate pens. They were rubbed thoroughly dry with a wisp of hay, and were then given the first milk of their dams (colostrum), and after the first few days were given ordinary mixed cow's milk. After fourteen days, the whole milk was gradually replaced by separated milk, with a small addition of linseed to replace the fat removed by the separator. The substitution of separated milk for whole milk was continued gradually until the calves were being fed on separated milk and linseed only, which occurred

when they were about a month old. The linseed was first ground and then thoroughly boiled in water and allowed to cool, when it formed into a jelly-like mass, which was easily mixed with the milk. Five ounces of linseed should be allowed for every ten pounds of separated milk. There are a few points of special importance to be observed, the neglect of which are sure to cause failure.

First.—The milk should be fed at a temperature of 100° F., and the exact temperature of the milk should be ascertained by using a thermometer, and not trusting to the sense of touch.

Second.—It is of the utmost importance that the vessels in which the milk is fed are always thoroughly clean. They should be thoroughly cleaned and scalded after each time of use. Neglect of this precaution will almost surely result in digestive disorders.

Third.—The intervals at which the milk is fed should be absolutely regular, and care should be taken that excessive quantities are not fed, as a slight deficiency is far preferable to an excess.

The advantages of this method of rearing calves are first of all the great saving in the cost of rearing which can be effected by substituting the fat of linseed for butter fat. Secondly, when rearing by hand it is possible to regulate the quantity fed, which is impossible when everything depends upon the milkman, which is the case when the calves are allowed to suck, many calves being lost owing to digestive disorders caused by irregular feeding. Thirdly, cows milked by hand will give more milk than if the calves are allowed to suck (some breeds of cows give no trouble at any time when the calf is removed, while others will go dry if their calf is taken away from them, but with these breeds no difficulty will be experienced if from the first calf onward the calf is removed immediately it is born and the mother not allowed to see it.) Fourthly, there is less danger of udders being injured, which often occurs through the calves impatiently butting when they are first let loose. Fifthly, it is a cleaner method, as when the calf sucks its dam, the udder and the hands of the milkman become covered with saliva, which is only imperfectly removed if they are not under the strictest supervision.

Fodders.

The fodder which has proved the most suitable for milch cattle is green maize, which has proved to be superior to any of the juars or other fodders for increasing the milk yield. Of the juars the sweeter varieties are of the least value as milk producers, particularly Shalu which either in the green or dry state invariably decreases the milk yield.

Silage is of the greatest value to the dairy. Its chief advantage is that it gives a cheap, safe and efficient means of storing fodder in its green state, at a time when it is abundant, and could not otherwise be profitably disposed of, and feeding it at any time required when green fodder is unavailable or can only be procured by expensive irrigation.

Maize makes the best silage, but any kind of fodder or grass can be utilized for this purpose. Plants with hollow stems should if possible be used for other purposes, as they are not so suitable for silage, owing to the stems containing air which should be excluded from the silo. The sweeter kinds of juar make a silage which is very acid, and also of course loose much of their original feeding value owing to the sugar being converted to acid during the process of fermentation.

We have found silage a splendid standby in the hot weather, being enabled by its use to keep up the milk flow as long as the silage lasted; the finish of the silage being followed by a marked decrease in the yield.

It is advisable to feed silage immediately after milking as there is a certain amount of smell about all silage, which increases with the sourness or acidity, and which odours would certainly cause the milk to have an offensive smell if absorbed by it. This can however be avoided by feeding after milking and not allowing any uneaten silage to lay about the cattle byre.

P. C. PATIL,
Acting Professor of Agriculture.

APPENDIX G.

SUMMARY OF WORK DONE UNDER THE EXTRA DEPUTY DIRECTOR OF AGRICULTURE IN THE KONKAN, 1913-14.

THE SEASON 1913-14 WAS GOOD.

A new farm.

2. The prevailing rock in the Ratnágiri District is laterite, whereas in the Thána and Kolába Districts trap is the most common rock. The conditions as regards soil, ect., obtaining in the two Northern Districts are distinct from those obtaining in the Ratnágiri District. An Experimental Farm for the Ratnágiri District was therefore sanctioned and opened in 1913, with the object of conducting experiments in the cultivation of rice, green-manuring for rice, growing profitable hot weather crops under irrigation, etc.

The Ratnágiri farm which has an area of 14 acres 19½ gunthas was occupied on the 20th May 1913. As there was very little time for taking up the plotting work and finishing it before the commencement of the monsoon, arrangements were made for conducting experiments in plots made by putting up temporary bands in the fields.

Rice.

3. *Green-manuring.*—At the Alibag Farm, five series of experiments were conducted for investigating the different methods of green manuring. In the first series, green manure seeds were sown on varkas land in the beginning of the monsoon, and the green matter raised was transferred to rice fields 5 days previous to transplanting. As water does not stagnate on varkas land, it was thought that green manure crops would grow well on it. In the second series, green manure seeds were sown in situ on rice lands in the beginning of the monsoon and ploughed down 5 days previous to transplanting. In the third series, green manure seeds were sown in standing rice crop with a view to plough down the crop when in flower. In the fourth series, the land was ploughed in the rabi season after kharif rice was harvested and sown with green manure seeds and the crop was ploughed down when in flower. In the fifth series, the seed of green manuring crops were sown and irrigated in order to start them on their growth before the commencement of the monsoon, and the plants were uprooted and transferred early in July to plots which were afterwards transplanted with rice.

In the above series of experiments, San (Crotalaria juncea) and Dhaincha (Sesbania aculeata) were tried as green manure crops.

Of the above five methods of green-manuring tried, only the last two proved successful. Dhaincha and San sown with tillage after the harvesting of kharif rice and ploughed down when in flower increased the outturn of rice in the succeeding kharif season. The increase per acre was 630 lbs. of grain, and 1,410 lbs. of straw in the case of dhaincha, and 670 lbs. of grain and 1,000 lbs. of straw in the case of san. In the other successful method of green manuring, san and dhaincha were sown under irrigation on the 13th April and 8th May respectively, so that they might produce good quantities of green matter by the time the seedlings of rice would be ready for being transplanted. They were uprooted in July and transferred to double the areas, which were afterwards transplanted. The average increase in the outturn per acre due to green manuring in this way was 560 lbs. of grain valued at Rs. 15-9-0.

At the Ratnágiri Farm, the outturn of kuryat rice land green manured with san sown in the beginning of the monsoon and ploughed down before sowing "rahu" or sprouted rice seed was increased by 477 lbs. of grain and 933 lbs. of straw per acre valued at Rs. 23-1-9. The cost of green manuring was Rs. 6-13-8 per acre.

4. *Oil cakes.*—Of the oil-cakes tried as manures for rice at Alibag, karanj cake yielded the best results. It was applied at the rate of 422 lbs. per acre. The increase in the outturn per acre was 370 lbs. of grain and 1,000 lbs. of straw.

At Ratnágiri also, karanj cake yielded satisfactory results. It was applied to both transplanted and rahu rice at 720 lbs. per acre. In both cases it increased the outturn.

5. *Fish manure.*—Fish manure was applied at the Alibag Farm to rice at the rate of 285 lbs. per acre. The cost of manure per acre was Rs. 14-11-0. The increase in the outturn per acre was 505½ lbs. of grain and 750 lbs. of straw valued at Rs. 19-0-0.

At the Ratnágiri Farm, fish manure was applied to transplanted rice at 400 lbs. per acre. The cost of manure per acre was Rs. 7-9-4. The increase in the outturn per acre was 1,040 lbs. of grain and 1,493 lbs. of straw valued at Rs. 25-2-8.

6. *Seed selection.*—Bhadas paddy seed selected on the farm by ear-to-ear selection yielded 108 lbs. of grain and 72 lbs. of straw more per acre than the ordinary Bhadas seed stored by cultivators.

7. *Rice varieties.*—Eight varieties were tested at the Alibag Farm. Of these the local variety called Patni (Halvi) yielded the highest outturn.

8. *Rab substitutes.*—It is often complained that the supply of rab materials for burning seed-beds is deficient and that most cultivators do not burn seed-beds with an adequate quantity of rab materials. The area of seed-beds to be burnt by each cultivator depends upon the area of rice land he cultivates. But the quantity of available rab materials being insufficient, he does not burn all his seed-beds properly. A scheme for burning only half the area of seed-beds properly with rab materials available and using rab substitutes on the remaining area of seed-beds has been devised. One of the advantages claimed for burning seed-beds with rab materials is that weeds do not grow on the burnt seed-bed and that seedlings can be uprooted easily. In the scheme referred to, the area burnt with rab materials in one year should be utilised for raising seedlings in the succeeding year with rab-substitutes. If seedlings were raised on such a seed-bed with rab-substitutes, no great difficulty as regards the growth of weeds and the lifting of seedlings would be experienced.

Rab-substitutes were applied at the rate of 2·5 lbs. of nitrogen per guntha of seed-bed. Seedlings were raised on seed-beds treated with rab-substitutes and also burnt with cow-dung rab and transplanted on comparative plots.

The results obtained are as follows :—

Field No.	Plot No.	Area in gunthas.	Treatment.	Yield per plot.		Yield per acre.		Remarks.
				Grain.	Straw.	Grain.	Straw.	
				Lbs.	Lbs.	Lbs.	Lbs.	
41	1	1	Transplanting seedlings from cow-dung rab	47	80	1,880	3,200	
41	2	1	Transplanting seedlings raised by applying fish manure to seed-bed burnt in the previous year	46	70	1,840	2,800	
41	3	1	Transplanting seedlings raised by applying karanj cake to seed-bed burnt in the previous year	55	65	2,200	2,600	
41	4	1	Transplanting seedlings raised by applying urine earth to seed-bed burnt in the previous year	51	70	2,040	2,800	

The above figures show that good results could be obtained by using rab-substitutes. The collection of rab materials in those localities, where wages are high and the sources yielding those materials scanty, has become costly. In such localities, the present practice of imperfectly burning all seed-beds may be replaced by one in which the whole available supply of rab materials should be burnt on as much of the area of seed-beds as it is sufficient for, and the remaining area treated by rab-substitutes. The seed-beds to be selected for treatment with rab-substitutes should be those burnt with rab-materials in the preceding year.

As regards the rab-substitutes tried in the above experiment it may be stated that fish and karanj cake are manures locally available in the Konkan. Urine earth can be prepared by putting earth on the floor of cattle sheds and by scraping and storing it after it is soaked with the urine of cattle.

The above experiment has been devised with the object of working out a scheme for the introduction of rab-substitutes, wherever the cost of collecting rab-materials is high or their supply deficient.

Paddy seed farms.

9. A system of paddy seed farms was proposed in the course of the year under report. If in a circle of a Táluka, 40 to 50 cultivators agree to buy properly grown and selected seed one of them having good land and other facilities should be selected to grow the seed required by them and his name registered. Only one variety which is most commonly grown in the locality should be selected and grown by the person selected to grow the seed required by others. Nearly double the quantity of seed required should be produced by the registered grower as all tail corn should be rejected as unfit for sowing.

This year the best seed available in the locality was supplied to the selected seed growers; but the selection of seed by ear-to-ear selection will be made in the current season, and seed so selected will be supplied to seed growers for sowing it next May.

Another method of selecting paddy seed, *i.e.*, of selecting a suitable single plant and sowing its seed in the succeeding year with the object of eventually producing sufficient seed for the registered growers will be initiated in the current season.

The work done under this system of supplying selected paddy seed to cultivators will be dealt with in the next report.

Transplanting ragi in Kánara.

10. Ragi is broadcasted in Kánara, whereas in the other Konkan Districts it is mostly transplanted by raising seedlings on "rabbed" seed-beds. An experiment was carried out in Kánara to test the two systems of growing ragi and the results are as shown below :—

Treatment.	Outturn per acre.	
	Grain.	Straw.
	Lbs.	Lbs.
Ragi broadcasted	430	1,710
Ragi transplanted	640	1,950

The above results show the superiority of the practice of transplanting ragi by raising seedlings on rabbed seed-beds.

Groundnut.

11. At the Bandhan sub-station excellent crops of groundnut were grown. Spanish peanut sown at 12″ × 9″ yielded better outturns than when sown at 12″ × 6″, 12″ × 12″, or at 12″ × 15″.

When the same variety was sown in squares at 9″ × 9″, 12″ × 12″, 15″ × 15″ and 18″ × 18″, the plots sown at 9″ × 9″ yielded better than other plots.

The three late varieties of groundnut—Virginia, Pondicherry and Big Japan—yielded better than the early varieties—Small Japan and Spanish peanut.

Irrigated crops.

Sugarcane.

12. In Kánara, nearly 100,000 sets of Red Mauritius sugarcane were introduced in the year under report. The local "Dascabbu" variety requires to be wrapped up with its leaves after it grows to a certain height. But in the case of Red Mauritius variety the leaves should be removed from the cane. This is a point in favour of Red Mauritius variety. Moreover, the Red Mauritius variety is found to be more free from the attacks of jackals, etc., than the local "Dascabbu" variety. It is hoped that with the introduction of this new variety the area under sugarcane in Kánara will gradually increase.

Onion.

13. This crop did better than any other irrigated crop at the Alibag Farm. With fish and poudrette as manure, it produced 22,900 lbs. of bulbs per acre valued at Rs. 359-12-8. The net profit per acre was Rs. 146-9-4.

The practice in Kánara is to plant small bulbs of onion for growing the crop; but in the last three years, seed has been tried and seedlings raised from it transplanted. During the year under report, profitable crops of onion were raised by the transplanting method at Manki and Ankola. This year the demand for onion seed is more than can be supplied.

Chillies and Tomato.

14. At Ratnágiri chillies and tomato did well. The Poona variety of chilli was planted and the outturn of the crop was valued at Rs. 300-0-0 per acre. Tomato grew well and its outturn was valued at Rs. 379-9-4 per acre.

Tobacco.

15. At Manki in Kánara, tobacco was cultivated under irrigation as a second crop on rice land. The outturn per acre was 840 lbs. of cured tobacco. The green manuring of the land with san was found to be beneficial for the tobacco crop.

Fodder crops.

The quality of fodder in the Konkan, *i.e.*, of rice straw and grass is poor. Throughout the hot season cattle get no green fodder or any other food that may be regarded as nutritious. Attempts were therefore made to grow special fodder crops on the farms. Maize and berseem grown under irrigation at the Alibag Farm yielded, respectively, 12,000 and 15280 lbs. of green fodder per acre.

At Ratnágiri, maize grown under irrigation yielded 12,560 lbs. of green fodder per acre.

Cattle.

17. The condition of cattle in this Division which is very unsatisfactory engaged the attention of the Department and the people. The Agricultural Associations at Pen, Sirsi and Honáwar have proposed to maintain breeding bulls. At Maroli in the Thána District, a Cattle

Breeding Society has been formed. The question of fodder also was studied. The cutting of grass before it seeds was advised. Ensilage was tried at Kalyan, Alibag, Panvel, Mahád, Honáwar and Sirsi. Fodder crops under irrigation, such as maize, lucerne and berseem were grown at several places.

Ensilage.

18. In 1911-12, ensilage was made on a small scale in a pit dug on the Rasani hill near the Alibag Farm. In order to gain further experience in silage-making, five pit siloes were made in the Alibag Táluka—two at Bandhan and three at Kaloshi, Veshvi and Mula. The silage made at Kaloshi and Bandhan was excellent. From the results of pit-siloing tried in the last two years, the following conclusions may be drawn :—

(1) The walls and bottom of pits which should be dug in high ground should be made smooth by ramming them.

(2) They should be filled with coarse, thick stemmed grass, such as Phool, Ber, etc. Thin stemmed soft grass is of no use for silage-making.

(3) The grass filled in the silo-pit should be properly pressed.

(4) When thick stemmed grass is in flower, it should be cut and filled in the silo pit and pressed.

(5) Cattle eat silage greedily; the best method of feeding silage is to feed it with rice straw.

Distribution of Seed and Implements.

19. The following quantities of san and groundnut seeds were distributed:—

Districts where distributed.	Quantity distributed. San.	Groundnut.
	Lbs.	Lbs.
Thána	4,180	1,338
Kolába	1,980	1,196
Ratnágiri	6,380	4,949
Kánara	3,300	1,400
Total ...	15,840	8,883

20. The following implements were distributed :—

Kind of implement.	Number sold.
Meston ploughs iron parts	26
„ „ complete	4
„ „ wooden parts	3
„ „ spare shares	19
W. K. S. Indian wooden plough...	11
American Road Scraper	2
Dharios and Datardis	2
Poona gul pans	4

Sindhi wooden ploughs are found to be suitable for Kánara and Ratnágiri. They do more work than the local wooden ploughs. At Sirsi, Messrs. Nilekani Brothers have taken up the manufacturing of light iron ploughs and iron mills for crushing sugarcane. At the Honáwar Agricultural Show, 40 Sindhi wooden ploughs and 28 light iron ploughs were distributed.

Denaturalised Salt.

21. In the course of the year under report, a scheme for denaturalising salt with 5 per cent. bone dust and 1 per cent. fuel oil, and supplying the salt so denaturalised at 10 annas per maund to cultivators for manurial purposes, was sanctioned by Government. Under this scheme, a total quantity of 2,100 Bengal maunds of denaturalised salt was issued to cultivators in the year under report as shown below :—

District.	Quantity supplied.
	Mds.
Thána	825
Ratnágiri	825
Kánara	450
Total ...	2,100

Minor Irrigation.

22. The question of storing water by constructing dams across ravines or streams with the object of utilising the water thus stored for irrigation was investigated as far as time permitted. At Umbergaon, a landowner proposes to construct a dam at a cost of Rs. 5,000 across the Sanjan stream to prevent the inflowing of salt water in the hot season and thus store sweet water for utilising it for irrigating his lands situated on the banks of the stream. He has submitted his application to the Collector for permission to construct the dam. The people of Avas in the Kolába District are engaged in preparing a scheme for storing water in the monsoon for irrigating high-lying rice lands in the monsoon.

Agricultural Associations.

23. During the year under report, the Kolába District Agricultural Association and the Associations at Honawar, Kumta and Sirsi did good work. The Ratnágiri District Agricultural Association was reconstituted in the course of the year. Some members of the Umbergaon Agricultural Association have taken up the cultivation of hot weather crops and two of them have installed oil engines and pumps for irrigating their crops.

Agricultural Shows.

24. During the year under report agricultural shows were held at Kalyan, Malwan, Mahád, and Honáwar. All these four shows were organised by local committees assisted by the officers of this Department and were highly successful.

Demonstrations.

25. At each of the Agricultural shows held in this Division, lectures and demonstrations were given by the officers of the Department. At the Bandhan sub-station, a special demonstration was given. The groundnut at Bandhan was excellent and the demonstration was attended by 333 cultivators.

Gul-making demonstrations were given by the Agricultural Overseer at six places in Kánara.

A party of 21 cultivators was organised and taken to Goa to study the systems of coconut cultivation in that territory. The party returned to their homes with much knowledge gained about the cultivation of coconut in Goa. Some of them want to take up new lands for planting with coconut.

Co-operation.

26. In the course of the year under report, the Agricultural Overseers and other Graduates stationed in this Division were instructed in the working of Co-operative Societies. They are beginning to work in co-operation with the most successful of Co-operative Societies. Most of the members of Co-operative Societies are small farmers and they have got their committees not only for financing them but also for influencing them to adopt improvements of an economic nature. What we shall be able to do by approaching and assisting industrious cultivators through their Co-operative Societies will no doubt surpass both, in quantity and quality, what has been done by associating ourselves with large landowners, whose number is small, and who are not engaged in farming as a business.

V. H. GONEHALLI,
Extra Deputy Director of Agriculture
and Assistant Registrar, C. S., K. D.

APPENDIX H.

SUMMARY OF WORK DONE UNDER THE ECONOMIC BOTANIST, 1913-14.

1. Enquiries.

Each enquiry mentioned below involves several letters. The number represents therefore not letters or specimens, but correspondences. Where possible, visits were paid to the lands of enquirers.

Subject.	Number.	Subject.	Number.
Botanical advice	9	Diseases	64
Books	2	Exhibitions	8
Citrus	21	Entomology	3
Chemicals	1	Ericulture	1
Fibres and Fibre plants	5	Plantains	4
Figs and Pomegranates	3	Rubber	2
Fodder grasses	6	Sericulture	2
Grape vines	5	Sugarcane	2
Horticulture generally	4	Soils	2
Horticultural Training and Education generally.	9	Specimens (supply of) ...	6
		Seed Testing	28
Identification of plants	22	Tapioca	1
Manures	1	Weeds and grasses	21
Mango	17	Wheat	1
Miscellaneous	64		
Plants and seeds	42		
...		Total ...	354

There is an interesting increase in the number of enquiries on plant diseases, *i.e.*, 64 this year against 48 last year. The majority of these continue to come from Superintendents of Government Farms, but it is satisfactory to note that they are made in an increasing number of cases on behalf of the public.

Two of the enquiries were concerned with prosecutions in which expert evidence was required as to the nature of certain plants and vegetable drugs. The specimens were identified in each case.

A set of herbarium specimens was prepared and sent to the Gujarât College, Ahmedabad. A large consignment of the flowers of Lavandula Burmanni was again collected and sent to Professor Sudborough of the Indian Institute of Science at Bangalore at his request for investigation of the oil. Specimens were again supplied to the Educational Department for Cambridge Local Examinations.

The plants and seeds received and despatched from Ganeshkhind Botanical Gardens were:—

Received.

Plants or seeds.	Number.
Plants	263
Seeds (bulk)	30 lbs
Seeds (small packets)	20

Despatched.

Plants or seeds.	Number.
Plants	28,774 includes seedling of annuals.
Seeds (bulk)	11 lbs.
Seeds (small packets)	204

2. Education.

The Economic Botanist and his staff took their usual share in the courses given to each of the three classes of the B. Ag. Course, the I.C.S. Course, and the Short Course. In addition

the following pupils have undergone the course in horticulture given in the Ganeshkhind Botanical Gardens :—

Name.	Community.	Period of training.	Work after training, actual or proposed.
1. Mr. Jall Cooverjee	Parsi	11 months ...	Managing his estate.
2. Mr. A. B. Marne	Marátha ...	3 months ...	Not known.
3. Mr. B. S. Maneksha	Parsi	7 months ...	Do.

During the College session specimens were supplied daily to the Agricultural College from the Ganeshkhind Botanical Gardens.

Mr. R. Beale completed his special training and joined the Burma Agricultural Department as Assistant Economic Botanist in May 1914.

3. Lectures and Publications.

The output of published material has been both large and useful. The following is a list:—

Magazine Articles.

Article.	Author.	Magazine.
Unisexual flowers	W. Burns, D. Sc., Economic Botanist.	Poona Agricultural College Magazine, Vol. V, No. 1.
Is Fruit growing economically sound ...	Do. ...	Poona Agricultural College Magazine, Vol. V, No. 3.
On variation in the flowers of Limnanthemum indicum.	H. M. Chibber, M.A., Asst. Prof. of Botany.	Journal and Proceedings, Asiatic Society of Bengal (New Series), Vol. IX, No. 5.
Seed structure and germination of Vateria indica .	Do. ...	Journal of the Bombay Branch of the Royal Asiatic Society, 1913.
Germination of three Indian plants	Do. ...	Journal of the Botanic Gardens, Buitenzorg, Java.
Leaf-fall in Indian Trees...	Do. ...	Journal of the Bombay Natural History Society, 1913.
Morphology of the Pectinate organs of Trapa Bispinosa.	Do. ...	Journal of the Bombay Natural History Society, 1914.
Notes on the Markets at Singapore and Batavia...	Do. ...	Poona Agricultural College Magazine, Vol. V, No. 4.
A Preliminary Note on the Study of the Rice varieties.	R. K. Bhide, Assistant Economic Botanist.	Do. do.
A Note on the Observations on Rice of Farneti Rodolfo.	Do. ...	Agricultural Journal of India, Vol. IX, Part 2, page 211.
The Castor Plant	T. Lobo, B. Ag. Graduate, Fieldman.	Poona Agricultural College Magazine, Vol. V, No. 2.
Grafting	G. B. Patwardhan, B. Sc., Assistant Economic Botanist.	Marathi Shetki and Shetkari, Vol. 4, Nos. 3, 4 and 5.
icultural possibilities in Western India ...	Do. ...	Marathi Shetki and Shetkari, Vol. 4, Nos. 8 and 9.

Separate Papers and Publications.

Paper or Publication.	Author.	How published.
Annual Report of Ganeshkhind Botanical Gardens, 1914-15.	W. Burns, D. Sc., Economic Botanist.	As Annual Report.
The Cultivation of Oranges and allied fruits ...	Dó. and H. P. Paranjpye, B. A., Assistant Economic Botanist.	In Report of Agricultural Conference held at Poona on 15th to 17th September 1913.
Fungoid diseases of plants and the work done in the Bombay Presidency in connection with them.	S. L. Ajrekar, B. A., Assis-Prof. of Mycology.	Do. do.
The Horticultural Possibilities of Western India .	G. B. Patwardhan, B. Sc., Assistant Economic Botanist.	Do. do.
A Guide to Rose Culture in the Bombay Presidency	Do. ...	As a Bulletin of the Agri-Horticultural Society of Western India.
Studies in Peronosporaceæ	G. S. Kulkarni, L. Ag., Assistant Mycologist (in collaboration with Dr. Butler, Imperial Mycologist).	In Memoirs of Department of Agriculture in India.
Fruit cultivation and Fruit Industry ...	L. B. Kulkarni, L. Ag., Graduate-Fieldman.	Paper read at Indian *Industrial* Conference.
Fig cultivation	Do. ...	Leaflet of Bombay Department of Agriculture.
Fruit culture	S. H. Prayag, B. Ag., Graduate-Fieldman.	Kanarese Agricultural Journal.
The Seed supply of the Poona District ...	Seed Testing Department.	Bulletin 55 of Bombay Agricultural Department.

Lectures have as usual been given at various centres especially on plant diseases and fruit culture.

4. Research.

The staff of the Economic Botanist have specialised on the same subjects as reported last year. The results of the various researches reported below are due to the workers who specialise in these subjects.

Fruit culture.

(*a*) *Mango.*—In private gardens, crown-grafting has been experimentally tried by the Economic Botanist's staff. It is conclusively proved that this method of grafting gives a very small percentage of success and cannot be recommended on this account. In Bassein, that system of grafting known as top-working, where the whole top of an old tree is reconstituted has proved successful and produced flowers within two years of the operation. Budding the mango was done on an extensive scale but this method, like crown-grafting, has far too small a percentage of success to be practically useful. An important result is the successful propagation of the mango by *layering*. It is possible that this method may to some extent replace grafting Propagation of the mango by *cuttings* however entirely failed. The most remarkable graftings have succeeded this year, namely, that of a fruiting shoot of mango on to a seedling stem, and one fruiting shoot on to another. These unusual unions were made in connection with a special research on the nature of the flowering and fruiting shoot. The salt manuring of mango trees has again given no conclusive results. The dug plantation gives larger outturn and is in a better condition than the undug plantation. There is yet little difference in outturn between pruned and unpruned trees. Resting the mango tree by root exposure gave no conclusive results. Artificial crossing of the flowers again failed to produce fruit. This is now the fourth year of these trials. Carefully packed consignments of fresh fruit were sent to London, Marseilles and Trieste by steamer to see if the fruits would stand the voyage. They were *not* in cold storage. The London and Trieste consignments were hopelessly rotten. A few of the Marseilles lot were useful. It is apparently out of the question to send fresh mangoes to Europe without cold storage. A small experiment in mango canning was made with a steam-pressure apparatus ordered from the North-Western Steel and Iron Works, Eau Claire, Wis. U. S. A. 155 tins were prepared and their condition will be reported on later. A consignment of 50 grafted plants was despatched to the Governor of Dongola Province, Sudan, in three packing cases. All the plants in one case were received in perfect condition, the other two cases had been badly treated on the way. In all 32 plants survived the journey.

(*b*) *Citrus.*—In the stock-testing experiments on citrus varieties (oranges, limes, &c.), the results continue to show that the Jamburi stock (*Citrus medica*, unknown variety) continue to do far better than those on the citron (*Citrus decumana*). Some of the trees on the latter stock died during the hot weather (April-May) 1914. Pomelo scions on citron stocks, however, gave a good yield of fruit in this, the fourth, year from budding. Onions proved a useful sub-crop to young citrus trees. Artificial hybridisation was successfully performed between the Ladu orange and the Sylhet lime. Many visits have been paid in the district to citrus groves reported by their owners to be diseased. In almost every case it has been found that soil conditions are at fault, especially as regards drainage and tilth. Nevertheless in spite of our advice on these points the owners often continue to do nothing, and doubtless blame the Agricultural Department for its inability to assist them. What such men desire is a magic manure. They have no interest whatever in such commonplace operations as drainage and weeding.

It has been found that citrus bud-wood packed in damp moss did not keep well, but that bud-wood packed in sawdust, wet by the rain, kept excellently and travelled well by the post even from America.

(*c*) *Guavas.*—Careful study of guava plants with a view to the reduction of seeds continues. In the districts experiments on the exposure of the roots of guava trees before flowering shows that the result of the operation is better and bigger fruits. Crossing of red and white guavas was unsuccessful.

(*d*) *Papayas.*—The papaya has been studied with a view to describing the various kinds of flowers it bears, and to see if there is any kind of cycle in their production. Interesting positive results have been obtained which will shortly be published. The October number of the Agricultural Journal of India contains the results of experiments on branching of the papaya and thinning of the fruits.

(*e*) *Pomegranates.*—Kabuli pomegranates scions grafted on stocks of Poona variety are doing well and will probably succeed where the Kabuli on its own roots failed. In Dhárwár it was found that spraying with crude-oil emulsion (10 oz. in 8 gallons water) was the most effective check on the boring insect, *Virachola isocrates*. (*Sursa*, in Marathi). This coincides with the Ganeshkhind results.

(*f*) *Grapes.*—Manurial experiments on grape vines are in progress at Nasik, Mundwa and Poona. This year fish plus sulphate of potash gave the best results in Poona, but the experiments are by no means complete yet. It has been decided to apply the manures after the April pruning so as to affect the wood on which the fruit-bearing shoots will develop.

Experiments are in progress at Násik and Poona to compare various methods of training the vines, and some results of these will be available next year.

Planting of blocks of grape varieties continues in the Ganeshkhind Botanical Gardens, Poona. 16 new varieties were introduced during the year, of which 11 survived.

(*g*) *Figs.*—The figs in Ganeshkhind Botanical Gardens were attacked by fig-rust (*Uredo Fici*) on their leaves but not on the fruits. This disease is not found in the main fig-growing area at Rajewadi, 30 miles from Poona. Mulching the soil of fig plantations with dry leaves was found to be of great use in conserving soil moisture during April and May. The best results have been obtained from plants on comparatively poor soil with good drainage. The foreign varieties of fig still drop their fruits and are useless.

(*h*) *Others.*—The cultivation of the following fruits was also studied:—Custard apple (*Anona squamosa*) Ramphal (*Anona reticulata*), Mamphal (*Anona muricata*), Phalsa (*Grewia asiatica*), Kamrak (*Averrhoa carambola*), Loquat (*Eriobotrya japonica*), Rose apple (*Eugenia jambos*), Plantains (*Musa sapientum*), Chiku (*Achras sapota*).

Plant Diseases.

An extensive demonstration of spraying vines against mildew was conducted at Násik in several vineyards. The material used was Bordeaux mixture plus soap. Three sprayings were given between October and March. The results, while satisfactory, were not so conclusive this year, simply because the mildew attack was everywhere slight. Spraying in Ganeshkhind Botanical Gardens completely protected the vines, while adjacent unsprayed plants were badly diseased.

The spraying of the Supari palm (Areca catechu) against the Koleroga disease (*Phytophthora omnivora var. arecæ*) was continued in several gardens in the Sirsi and Siddapur tálukas of the Kánara district. The material used is a special strong Bordeaux mixture with soda and resin added as an adhesive. This spraying has been done for three successive years in some of the gardens, and, in addition to the immediate good effects of the spraying, its cumulative influence is now showing in the decrease of the number of trees attacked and the increase of yield of nuts.

An experiment was carried out at Manjri Farm by the Assistant Professor of Mycology to test the efficacy of steeping sugarcane sets in copper sulphate, to prevent the smut of sugarcane (*Ustilago sacchari*). The conclusions drawn are (1) that infection is carried in diseased sets; (2) there is also aerial infection from spores, and (3) steeping in copper sulphate solution (2 per cent.) is not by itself sufficient to prevent smut.

The ubiquitous soil fungus *Rhizoctonia* causes rot of underground organs, and potatoes are often attacked. Steeping seed potatoes in corrosive sublimate solution (2 oz. to 18 gallons water) gave inconclusive results.

The study of the red rot of sugarcane, the smuts of cereals and *Rhizoctonia*, is being continued.

It is not out of place to mention here the excellent research work now being done by a present student of the Agricultural College, Mr. H. L. Van Buuren (of Ceylon), on the root parasites of the Bombay Deccan. Chiefly among these parasites is the dreaded Tahuli or Tavali (*Striga* species). The methods of infection are being closely studied with a view to finding a remedy.

Fodder.

Figures have now been got showing the yields per acre, number of cuttings possible, &c., for the wild fodder grasses under experiment. The fodder value of these, in so far as appreciation by cattle goes, is now also determined. Figures as to length of life, time of harvesting, &c., have also been secured. With these data in hand it is desired to make an experiment on a larger scale outside the Ganeshkhind Botanical Gardens and the College Farm, but difficulties have arisen in getting land. At Manjri where such an experiment was made, it was found that in unploughed land amongst the already established grasses the sowing was a failure. In ploughed land success was only moderate. There seems little doubt that to start these grasses properly a very thorough cleaning of the land is necessary. After the grasses have really established themselves, it is probable that they will be able to keep out any invading plant The difficulty is to get a place where the grasses would be given a fighting chance at all, since this would mean the fencing in of the area for a year at least.

Rice.

This important research is being steadily pursued by Mr. R. K. Bhide. To test the effects of environment on certain characters of importance for classification, varieties (pure line seeds) were sown in tubs in Ganeshkhind Botanical Garden, and the treatment classified as wet, dry or salt according to the condition of the soil artificially maintained. Transplanted varieties subjected to the wet treatment flowered earlier than those subjected to the dry treatment, by, in extreme cases, as much as a fortnight. The salt treatment checked growth and

delayed flowering in many cases by as much as eight days. In wet undrained conditions a deeper colour of husk was produced than in dry drained conditions. In the salt undrained conditions a still deeper coloured husk was produced. The salt and the dry treatment produced grains somewhat smaller than those from the wet treatment. There appears to be a certain amount of natural crossing seen by the splitting of characters in certain progenies. Certain characters appear to be correlated, *e. g.*, course grains are more or less associated with hairy leaves, and fine grains with leaves that catch the finger with small points but without hairs. Several crosses between varieties were artificially made and the progeny of these will be examined in the ensuing season. The main centre of the rice work was at Alibag where many varieties (pure lines) are sown. Two tentative classifications have now been made, the one based on agricultural and the other on botanical characters. At Gokák and Surat, duplicate plots of certain varieties were sown to see if their characters changed with the new environments. At Surat none of the varieties came to maturity. At Gokak the result were even less encouraging. The plots were not irrigated, and it is intended to repeat the experiment under irrigation. In the laboratory, measurements of dimensions and weight of grains of different varieties have been made and photographs taken of typical grains.

Weeds.

The study of weeds is being continued. Nothing has yet been published on this head.

Miscellaneous.

Last year were concluded experiments by the Assistant Professor of Botany on the possibility of introducing Shingada, the waternut (Trapa bispinosa), into tanks in the Presidency. In two cases seeds failed to germinate. In another the life-history of the plant was shortened by changed conditions and the crop was missed. Insect pests are numerous, and the local vegetation of tanks interferes considerably with the Trapa. The Basmati variety from Kashmir showed itself the best both as to growth of plant and flavour of fruits.

Castilloa rubber trees at Bassein were tapped and the product sent to the Imperial Institute, London, for report.

APPENDIX I.

REPORT OF THE AGRICULTURAL CHEMIST FOR THE YEAR 1913-14.

1. The office and laboratory of the Agricultural Chemist to the Government of Bombay have been under my charge for the whole year under review.

2. The routine analytical work of the laboratory still shows a tendency to increase. It has been the heaviest year the laboratory has ever had, chiefly, but not wholly, due to a very large and extensive series of soil and water analysis done in connection with the survey of the canal areas of the Deccan carried out by a special officer. For this purpose, however, a special staff of three assistants was employed, and were still working at the end of the year. The following table shows the gradual increase in the analytical work of the laboratory since it was founded in 1906.

	1906-07.	1907-08.	1908-09.	1909-10.	1910-11.	1911-12.	1912-13.	1913-14.
Soils	67	101	311	347	281	378	319	1,076
Manures	43	105	91	205	184	195	251	329
Feeding stuffs ...	17	41	17	107	33	114	208	210
Waters	22	80	266	403	328	362	609	364
Gul and sugar ...	32	76	7	56	10	5	4	12
Beet root	...	...	36	11	1	...	...	1
Oil-seeds and oils ...	47	98	146	278	190	72	161	177
Milk	233	666	257	546	73	206	152	119
Condensed milk ...	...	...	2	...	1	...	...	6
Cream	123	1	1	...	...	...	1	2
Butter and ghee ...	2	2	2	16	12	...	4	12
Tapioca	...	...	...	46	9	...	...	...
Fruits	...	...	...	...	...	...	...	76
Miscellaneous ...	10	22	17	104	94	91	62	134
Total ...	596	1,192	1,153	2,119	1,216	1,423	1,661	3,018

3. As I have always maintained, however, the real test of the success of the laboratory in filling a public need, is best shown by the use made of it by the public, both by actual cultivators and by those responsible for industries directly dependent on agriculture. The number of samples received for analysis from the public, as distinguished from those from Government farms and departments, has regularly increased from year to year, as the following table of such samples shows, the figures being given since 1907-08.

	1907-08.	1908-09.	1909-10.	1910-11.	1911-12.	1912-13.	1913-14.
Soils	15	14	23	59	81	128	63
Manures	12	11	11	73	54	131	154
Feeding stuffs	3	2	17	11	45	56	56
Water	11	16	15	38	31	28	270
Gul and sugar	...	...	...	...	4	4	10
Oil-seeds and oils	...	...	...	...	20	31	27
Milk	...	4	17	2	7	98	23
Cream	...	...	...	...	...	1	2
Condensed milk	...	...	...	...	...	...	6
Butter and ghee	...	...	13	10	...	2	12
Miscellaneous	...	...	41	56	34	47	95
Total ...	41	57	137	249	276	526	718

4. The importance of the examination of water samples is indicated by the very large numbers sent to me from all over the Bombay Presidency chiefly with regard to their utilisation for purposes of irrigation. The question is a very important one in connection with water from the trap area in Western India, or near the sea coast, and there have been many cases of land being spoilt by unsuitable water. During the year I have been able to advise the avoidance of waters which would have inevitably injured the land if it had been used. In connection with the work of the Agricultural Engineer, it is a standing arrangement now that he will not recommend the putting up of an engine for irrigation purposes, until I have examined the water and the soil to see if the land is suitable and if the water is liable to cause damage to it. Furthermore, whenever a boring is made, I examine the water obtained before it is recommended for use for irrigation purposes.

5. The oil-pressing industry, which my laboratory has done a good deal to foster, is slowly expanding. The price of oilcake is rising, and this fact alone will cause an expansion with certainty. Castor cake is sure of a local market at reasonable prices, both in Gujarát and in the surgarcane tracts of the Deccan. The groundnut cake now made extensively in Western India is of excellent quality and has an assured market abroad. Safflower seed-pressing, which has extended much during the last year, is not yet on a sound basis. Most of the mills have tried to produce cake without decortication; and, as my analysis show, the cake so produced is very poor stuff for manure and practically useless for feeding, it only contains a little over three per cent. of nitrogen, and this is very low for a manure cake. Our mills which press this seed will have to learn that, for whichever purpose the cake is to be used, a certain amount of decortication is necessary. If fairly thorough decortication is done the cake becomes the best manure cake we have, and an excellent material moreover for feeding.

6. I may note one or two new manures which have become available during the year. Messrs. Croft, Mody & Co. have put an excellent nitrogenous manure on the market chiefly composed of animal refuse and a little bone, under the name "Nitroman", which gave the following analysis—

Nitrogen	...	...	...	14·79 per cent.
Phosphuric acid	...	...	...	0·31 „

This was offered at Rs. 160 per ton, and at that rate seems a satisfactory concentrated nitrogenous manure is available in fairly large quantities. Another material obtainable now in Bombay is dried blood, of which a sample was sent to me recently containing 8·32 per cent. nitrogen. This was priced at Rs. 120 per ton—an excessive amount.

7. Generally speaking the use of artificial manures other than oilcakes and fish is gradually extending, but only very gradually. This year the amount of Sulphate of Ammonia employed is about 100 tons in our area—an amount which will rapidly increase if the price of manure cakes continues to rise. A complete artificial mixture has given excellent results on potatoes in a number of cultivators' fields in the neighbourhood of Khed, and its use will probably be taken up considerably in the present season. And considerable efforts are being made to push Nitrate of Soda as a manure. The extension of the use of these manures will be slow, and great patience will be required on the part of those who are pushing their use.

8. A very great many examinations of milk have been done during the past year in connection with the rise to the front rank, as a question of importance, of the question of the supply of milk to cities. My chemical staff assisted me in the early part of the year under review in a careful and detailed examination of the milk-supply of Poona City, taken as a typical Indian town including its source, its quantity, the methods of obtaining it, and its quality. The results were embodied in a paper read at the Agricultural Conference in Poona in September 1913, and since reprinted in a number of places. Since that time milk samples have been constantly pouring in, and the proof that eighty per cent. of the milk-supply of our big cities is adulterated is a matter which, it is hoped, will soon lead to drastic action.

9. On the outbreak of the epidemic of cotton fires in Bombay on March 23rd 1914, an epidemic which continued till June, I was appointed by Government on the Committee of investigation of these fires. This involved me spending the greater part of the month of May in Bombay. As a result, I was able to show to the satisfaction of the Committee that under the conditions of storage in Bombay, spontaneous ignition would not occur, and that the source of the fires must be found in another direction. The report of the Committee including a note on my investigations is now before Government.

10. The other investigations on hand last year have been continued in my laboratory and some new ones commenced. The chemical study of the betel vine—the most important garden crop in India—with the ultimate object of ascertaining whether the quality of the leaf cannot be improved by modifications in the methods of cultivation and preparation for the market, has been continued. And a second memoir on the subject is being prepared. The publication of the results of other work has been delayed by the heavy character of the routine work. But there are on the anvil several other papers at present: on the agricultural well waters of the trap area: on the hot spring waters of the Konkan (in conjunction with Mr. S. R. Paranjpye): on safflower oil (in conjunction with Mr. N. V. Kanitkar): and on buffalo milk (in conjunction with Mr. D. L. Sahasrabudhe). My Assistant, Mr. D. L. Sahasrabudhe, has made a very interesting study of the acid

secretion of the *gram* plant, so much used as a medicine in the bazaars, which owes its acidity chiefly to malic acid,—and this will be published as a bulletin of the Imperial Department of Agriculture in India.

In new work, my staff have undertaken on the suggestion of Mr. W. W. Smart, the late Director of Agriculture, a thorough study from every point of view of a typical Deccan village, and exceedingly interesting results have already been obtained. Further, a beginning of a thorough examination of the very peculiar methods adopted in the cultivation of spices in North Kánara has been made.

11. My staff has worked well during the year. Mr. V. A. Tahmane, B. Sc., L. Ag., has remained Senior Laboratory Assistant throughout the year and the other members of the laboratory staff have not been changed. Messrs. V. J. Atgur, B. Ag., and N. R. Gurjar, B. Ag., have been specially employed in connection with the survey of soils in canal areas, while Mr. S. R. Paranjpye, B. Ag., is in charge of the district work on artificial manures which is under my control.

HAROLD H. MANN,
Agricultural Chemist to the
Government of Bombay.

APPENDIX J.

ANNUAL REPORT OF THE AGRICULTURAL ENGINEER, BOMBAY PRESIDENCY, 1913-14.

I held the charge of the appointment of Agricultural Engineer throughout the year and there were no important changes in the staff except the reversion of Mr. Nagindas to the P. W. D. and Mr. Chitale's promotion to the Boring Overseer's post for the Bombay Presidency.

The interest taken in this branch of the Agricultural Department by the cultivators is increasing rapidly. This is emphasized by the fact that the total number of enquiries received from all sources during the year under report amounted to 319—an increase over the previous year of 100 per cent., full particulars of which are given later on in this report.

Pumping.

Pumping is certainly the most important section of this branch of the Department.

Account of Running Expenses.

Unfortunately there are very few owners of pumping plants who care to keep accounts of expenditure, or ever dream of comparing their own figures with those of mhote irrigation.

Under the circumstances it is difficult for a Government Officer to ascertain the expenditure incurred by the plant owners and produce correct figures for comparative tests. During my tours, however, I have succeeded in collecting a few figures from men whom I consider reliable, and, as a result of this, I am able to give the comparative cost of mhote and pump irrigation as per tables attached at the end. It is obvious from these tables that power pumping is a much more profitable method of irrigation than mhotes.

Pumping Plant Failures.

The failure of a pumping plant can be avoided if the cultivators or prospective owners will observe the following :—

H. P. of Engine.

The H. P. of the engine should be the continuous H. P. under full load and not the maximum the engine can develop. Otherwise the engine will not be able to transmit sufficient power to the pump for any lenth of time and the project will quickly prove a failure.

A very striking instance of how firms even of good repute are anxious to sell machinery, and how very careless they are about the ultimate result of the plant, is given below.

A cultivator of Dantali, a village near Nadiad in Nadiad táluka of Kaira district, applied for a tagavi loan amounting to Rs. 2,500 which was to be spent on the improvement of his lands and installing a pumping plant. This man sent with his application for the loan in question an estimate received from a Bombay firm of high repute for the plant required, and it appeared that the tagavi loan was about to be granted on the strength of this estimate.

The Collector, however, stated in his final memo. that the Agricultural Engineer should be consulted in the matter. I found that the cultivator could not give the particulars necessary to enable me to check the estimate sent him by the firm. I then arranged for a visit to the site and found the estimate absolutely wrong and I asked the cultivator to show me the correspondence that had passed between him and the machinery agent.

In his letter of enquiry, the cultivator wrote : "I have a well in my fields and I want to irrigate 30 acres of land with the water of this well". The firm, without enquiring even about the distance between the *tharola* and the water level, estimated for a 4" centrifugal pump and a 10 B. H. P. oil engine. On calculation it was clear that a 3" centrifugal pump would require at least a 20 B. H. P. engine at that particular site. I was astonished at such business methods and absolute indifference to the cultivator's welfare. It is obvious that so long as this system of selling and purchasing goes on, there is little hope of making this class of machinery generally successful. I therefore advised the cultivator not to purchase such machinery and his case will be dealt with by this department.

Trained Drivers.

Careless driving is detrimental to a pumping plant and unless a good driver is employed the plant cannot possibly be expected to pay. Already a few intelligent coolies are being trained in this department, and from this class of men the cultivators will in future be able to procure suitable drivers to run their own plants.

In estimating for a pumping plant I always take this item into consideration which is shown under the head "Running Expenses" and a man's pay of Rs. 15 per month is usually allowed.

It has been discovered, however, that after the plant has been handed over to the cultivator, he has in some cases engaged a man on less pay; in one instance as low as Rs. 8 per month was paid. This is a suicidal policy. The enterprizing owner can manage his own plant with a little care, and it is pleasing to note that there are such men very anxious to learn.

Suitable Pump.

The pump itself should be designed to work against the total head, *i. e.*, manometric which includes static head plus pipe, bend, impeller and foot-valve friction, and not one that will work against the static head only. In the latter case the pump will not deliver any water and the plant of course will be useless.

I will give an instance of such a failure:—

The site in question is at Sultanpur, a village in Ahmedabad District. The Thakor Saheb of Tintoi spent some thousands of rupees in fixing a pumping plant to irrigate some waste land obtained from Government. So far he has not been successful in irrigating this land. The Collector of Ahmedabad requested me to visit his site and inspect his plant and endeavour if possible to save the owner from further loss. I surveyed the site, inspected the plant, and on calculation found that the pump was designed to work against a total head of 50 feet, whilst at this particular site the pump should have been designed for a total head of 75 feet. The Thakor Saheb has since then increased the area under cultivation, this necessitates a pressure pump. I am accordingly remodelling the plant.

Distributing Channels.

Another matter equally important before the success of a plant can be assured is the distributing channel; in many cases I find these channels so defective that half the water pumped is run to waste, consequently increasing the annual expenditure from 50 to 60 per cent.

This Department erected two pumping plants for private owners at Turmuri village, in Sampgaon Táluka of Belgaum District, but a pucca distributing channel was not built. The owners were convinced, however, that unless some sort of piping was laid down from the discharge tank their plant would never pay as the ordinary channels leaked so badly. I have now their cases on hand, and am arranging for pipes. The plants in question should then be quite efficient and profitable undertakings.

Suitable Pipes.

In some cases fields are undulating and have nallas intervening which render the ordinary channels quite useless to convey the water. In such cases earthenware, corrugated, or plain piping on the Syphon principle is necessary.

Sufficient Water-Supply.

A prospective power plant owner informed me at the time of survey that the water-supply of the river at his site was exceptionally good, and that he had never known it to dry up; on this assurrance a plant was designed and erected. The plant after erection unfortunately had to remain idle owing to the fact that the river completely dried up. Consequently only six-monthly crops can be grown. To avoid this sort of thing in future I shall be compelled not only to mark high and low water levels but to satisfy myself with regard to water-supply at each site before installing a plant.

Suitable Soil.

Steps are taken with regard to the suitability of soil before a pumping plant is installed.

Extent of Irrigated Area.

The exact number of acres and the contour of the land should also be known beforehand, so that the correct size of plant may be designed and erected, which can then be properly utilized and in this way get a good return for the money expended.

Remedies.

To obviate the difficulty with regard to H. P. of the engine, and the capacity and type of pump for any specific head, I have, with the Director of Agriculture's consent, issued the following letter to each Collector:—

(Circular letter from the Agricultural Engineer, Bombay Presidency, Poona, to all Collectors in Bombay Presidency.)

Sir,—I have the honour to state that since taking up my work as Agricultural Engineer I have discovered a few deplorable power-plant failures in certain parts of the Bombay Presidency, which are the direct result of bad and careless design, and I am informed that there are many more such failures in different localities.

I have brought this matter to the notice of the Director of Agriculture, and he has instructed me to issue this circular letter to all the Collectors in Bombay Presidency with a request that they will before granting Tagavi Loan submit the cultivator's case to this office, and that they will ask the District Officers to advise the cultivators to consult me before placing an order for such machinery.

This proceeding will enable me to investigate the local conditions so far as altitude, water levels, belt drive, and horse power are concerned; from such data I can design a suitable plant and state definitely what class of machinery is best adapted to suit each individual site.

In this connection I very much regret to say that many of the Bombay Firms do not take the trouble to study the cultivator's requirements, but simply quote them for machinery in a haphazard manner. This is suicidal policy especially as there is such a future for this class of machinery.

It is not my intention to prejudice cultivators in the selection of machinery, but simply to give them such definite data as the actual Horse Power required, the type of pump, and if crude, kerosine, gas, or steam is preferable as fuel for their particular case. This will enable them when soliciting quotations to state the actual Horse Power the engine should develop, the type of the pump best suited to deliver sufficient water to the land, and the relative position of engine and pump so as to set up a successful combination.

If cultivators wish to place the matter in my hands, I am prepared to make the necessary purchase for them, erect the machinery, and hand it over to them in good working order.

I have, etc.,

(Signed) W. M. SCHUTTE,
Agricultural Engineer, Poona.

I venture to think that this arrangement will prevent unsuitable projects being financed at Government expense. When I am conversant with full particulars of each site I will endeavour to see that only suitable machinery is sold to the cultivator. He can, however, purchase such machinery direct from the Firms in Bombay and can make his own arrangements for erection, provided I am satisfied that the H. P. and size of pump are correct.

This assistance is rendered gratis, and I shall always feel it my duty to persevere in this direction with a view to prevent needless failures, and trust the cultivators will take full advantage of my help and assistance.

To remove the difficulties in determining the highest point of land, and a suitable line for the distributary channels, I have suggested that a Pumping Overseer be appointed, whose duties will consist principally in using the Dumpy Level at the various sites, so as to enable me to prepare sectional drawings from which the correct position of discharge can be determined; this work will necessitate the Pumping Overseer remaining at some of the sites a fortnight, the result of this will be that all the water pumped will be distributed economically.

To remove the difficulty in deciding the correct amount of water for the various crops, I am gauging the supply in the various districts and designing plants according to the readings I get.

Maintenance of Machinery.

Careful and efficient handling of machinery is one of the most important points to be considered by a power-plant owner. Assuming a plant is erected under the very best supervision and is delivered to the owner at the conclusion of a satisfactory test by an engineer, the owner or cultivator in a few hours can damage the whole plant if he is careless. Careless men should not be trusted with machinery.

This Department in 1913 erected one of the best pumping plants that was possible to obtain for a cultivator and handed over the same in excellent condition. The owner was unfortunately as careless man that is possible to find, consequently the plant has been disabled on four separate occasions, each time I executed repairs and explained the method of driving. I am convinced, however, that he will inflict the same damage again simply because of his indifference and abject carelessness.

If the advice that is freely given by this Department is made proper use of, I can with confidence assert that every plant will prove a success.

2½" Pump for Wells in General.

In my last report I promised to publish results of the tests made with a 2½" Centrifugal Pump that was specially designed for well irrigation. Such tests were made and the pump can now be recommended as an efficient appliance for the raising of water from wells. A technical description will be published shortly in a note on Pumping. This pump will give one watering to 16·6 acres of sugarcane in 10 days. As an alternative it will irrigate 13·3

acres of garden crops every week of 6 days. This quantity of water is I think the capacity of many wells in the Deccan, Khándesh, and the Karnátick. In Guzerát it is possible to fix a 3″ and 4″ pump in some of the wells.

The 2½″ and 3″ sizes of pump have been successfully installed at Surat, Gokak and Poona, and are doing excellent work.

Deep Well Pumps.

Suitably designed borehole pumps to raise water from 3″ and 4″ boreholes at depths of 100 feet will solve a great problem in Indian Agricultural Engineering. Experiments with this class of pump are being made on the College Well with a view to installing the most suitable design to work in conjunction with the boring machines. Particulars of these will be given at a later date.

Number and Division of Enquiries.

Enquiries from all sources amount to 319 against 157 the previous year which may be divided as under :—

Pumping	131
Boring	169
Cane Crushers	3
Steam Plough	10
Engine Driver's Class	6

One hundred and thirty-one pumping enquiries have been received from various parts of th e Presidency and may be summarized as under :—

Enquiries from Northern Division	18
Enquiries from Central Division	50
Enquiries from Southern Division	28
Enquiries from Sind Division	5
Enquiries from outside Bombay Presidency	25
Enquiries from Bombay City only	5
	131

Nearly all these sites were surveyed as minutely as time allowed, and estimates were prepared for suitable pumping plants which were afterwards submitted to the enquirer for consideration. All this is done free of charge and owners are allowed to purchase machinery at any place they like provided it is in accordance with the size given in the estimate.

"Purchase and erection of Machinery for Private Cultivators."

The owner if he so desires may have machinery purchased and erected at his site by the aid of this Department. He has only to send a certain sum of money to cover the amount shown in estimates and supply raw material, etc. This Department then arranges everything for him and gives him the benefit of the special trade terms offered by the Bombay Firms.

Account of Private Money received.

A clear account of money deposited by the cultivator is kept and a statement of such account submitted when the work is complete. A specimen copy of this method was published in last year's report. Apart from getting trade terms the owner has drawings and designs prepared free. The only item charged is fitter's wages and travelling allowance, but this charge never covers the amount actually spent by Government. The owner usually paying half the actual cost.

A careful test is made of each plant after erection and repairs are also effected when necessary and advice is always given. Of course the machinery purchased and erected by this Department has my first attention for repairs, etc., although plants purchased and erected outside the Department receive due consideration.

Mhotes.

Certainly one of the most common means of irrigating throughout India is by mhotes. From the comparative statements attached at the end it will be seen that the figures are in favour of power plants, those for mhotes whilst much more per acre per annum only deal with a very few acres, on the other hand the power pump commands a much larger area, it is obvious that by resorting to power pumping the cultivator has a two-fold advantage.

Flow irrigation is of course cheaper and requires less labour but there are thousands of acres in India not commanded by these projects, which can only be brought under cultivation by means of well or river irrigation. In other words power pumping is the only profitable alternative to flow irrigation having for the prime mover either the oil, steam, gas or crude oil engines.

Hydraulic Rams.

Hydraulic Rams are a handy device for water raising but they require special conditions which are rarely found in this country.

Nangaon Pumping Plant.

The large experimental pumping plant at Nangaon has not been fully employed partly owing to the fact that a portion of the area is unsuited to irrigation and partly to the construction of suitable distributing channels.

However during the two years it has been at work 1358 hours. 320 acres have been irrigated and the running expenses work out at Rs. 30 per acre per annum. This is a much cheaper method than by mhote and when the area under irrigation is increased the cost per acre per annum will be decreased.

To remove the danger of irrigating unsuitable soil, I now arrange for the soil at each site under consideration to be analyzed before any further steps are taken and only in case the soil is suitable do I proceed with a pumping plant erection.

Steam Ploughing.

This Department has received several enquiries on the subject of Steam Ploughing, but many of them on hearing that a sum of Rs. 40,500 is required to purchase a set of this tackle give up the project simply because they consider the price prohibitive. It was however necessary in the interest of Agriculture to demonstrate the use of this special plant and show if possible that profits could be realized. Accordingly a set of ploughing tackle was purchased and set to work in Ranebennur táluka in the District of Dhárwár. Here the plough was worked from 2nd November to the middle of May last. During this time it ploughed 770 acres from 16″ to 18″ deep. After allowing for interest, depreciation and repairs a profit of Rs. 607-5-7 has been realized on the season's working. A report of the season's work is attached.

Probably some syndicate in future will take up the question of Steam cultivation on a large scale, since it has been demonstrated by Government to be a paying concern and it is needless to say that there is an immense scope for such an enterprize in this country.

Shallow Ploughing in light soil.

This will shortly be demonstrated in Guzerát where the Collector of Kaira has given some thousands of acres of waste land for cultivation. Here the conditions are much more favourable than at Ranebennur and I have no doubt that the result will in every way be most satisfactory.

Motor Plough.

Experiments are about to be made with a small motor plough on the College and Manjri Farms. This implement is supposed to plough two acres per day from 6″ to 8″ deep. At the conclusion of these experiments I shall be able to publish some reliable figures with regard to this particular class of work.

The recent experiment with the Steam Plough at Ranebennur undoubtedly proves that it is both effective and profitable and has no real competitor in the field of deep ploughing either in point of speed or efficiency, and I do not doubt but that the motor plough will serve a very useful purpose where very small detached plots of land are concerned.

Cane Crushing.

This has been carried on at Manjri Farm for the last five years and has proved successful. A perusal of the Farm reports will prove this assertion.

The work of installing a power cane crusher has also been successfully accomplished at the Government Farm, Gokak, and has completed its first season's work. A statement of figures showing the amount of profit over animal power crushers prepared by the Superintendent of that Farm is attached.

Many cane growers have recently enquired about small power crushers and this year I have purchased one of these mills requiring approximately a 4 H. P. engine to work it. I intend to instal this set at the site of one of my pumping plant owners, who is going to drive it alternately in connection with his pump.

Blasting.

Experiments have been made with Geleginite in the Belgaum district but the cost so far does not compare favourably with the country method of blasting. I anticipate however, that next season when my own men are efficient in the handling of this explosive a much better result will be possible, in fact I hope to have quite a number of men who will be capable of taking charge of blasing with explosives, and so eventually I shall be able to compete with the country method in point of cheapness.

" Power Plants already erected and owned by the Department."

Gokak	5 Roller Sugar Cane Crusher. 14 B. H. P. Oil engine and 5″ centrifugal pump, and 1½″ juice pump.
Loni	3 B. H. P. Oil engine with steel engine house and 2″ Semi-turbine pump.
Surat	2-2½″ Centrifugal pumps and a portable 6 B. H. P. Oil engine; one 6½ B. H. P, fixed engine with rotary pump, cotton gin and chaff cutter.
Nadiad	One 2″ pressure pump and 6 B. H. P. oil engine.
Experimental College Well...	14 B. H. P. Oil engine, 16 B. H. P. oil engine and a 3″ pump and a 10 B. H. P. Vertical Crude Oil engine.
Ganeshkhind Gardens ...	8 B. H. P. Oil engine and 3″ Centrifugal pump.
Nangaon	2-2½″ Auxiliary pumps. 1-10″ Victoria Turbo pump. 1-15″ do. do. 1-37 B. H. P. Gas Engine.
Dhárwár	6½ B. H. P. Portable engine and 2½″ Centrifugal pump and one 3″ rotary pump and one Cotton Gin.
Manjri	18 B. H. P. Engine, one crusher and one juice pump.

Plants erected for Private Owners, during the year under Report.

Turmuri	20 B.H. P. Kerosene oil engine and a 6″ Centrifugal pump.
Ode	8 N. H. P. Hopwood Boiler and a 6 × 6 × 6 Duplex Steam pump.
Dahivadi	15 B. H. P. Crude Oil engine and 5″ Centrifugal pump.
Vansol	8 N. H. P. Hopwood Boiler and 6 × 6 × 5 Duplex Steam pump.
Karulkar	10 B. H. P. Oil engine and a 4″ Centrifugal pump.
Fursungi	6 Roller power Cane Crusher.

These owners are capable men and all of them have been taught how to attend to their own plants.

Power Plants for Government completed during the year under Report.

Gokak	5 Roller sugar cane crusher 14 B. H. P. Oil engine, 3″ pump and 1½″ juice pump.
Loni	Oil engine of 3 B. H. P. with a steel shed, 2″ semi-turbine pump.
Experimental College Well...	14 B. H. P. Oil engine and 2 and 3″ pumps, a 10 B. H. P. Oil engine and a 16 B. H. P. Oil engine.
Jalgaon	Steel Shed.

Power plants under construction.

Sangvi	15½ B. H. P. Oil engine and 5″ semi-turbine pump.
Bhambora	60 B. H. P. Crude Oil Engine and 10″ pump.
Koregaon Bhima ...	10 B. H. P. Oil engine and 3″ Centrifugal pump.
Agarkhed	Re-erection of 25 B. H. P. Crude Oil engine, 6″ Centrifugal pump with discharge tank, Tower and stoneware piping.
Kendal	6½ B. H. P. Oil engine, 2½″ Centrifugal pump.

Government Plants under construction.

Jalgaon	... ...	9½ B. H. P. engine. 10″ Eagle Saw Gin, 1 Chaff-cutter and one pump.
College Experimental Well .		23 Water lifts and workshop machinery.
Loni	... ...	Grinding Mill Chaffcutter and Piping.
Gokák	... ...	2000′ of stoneware piping and chaff-cutter.

Repairs undertaken during the year under report.

Bágalkot	... ...	Overhauling the engine, pump and countershaft. Renewing the foundation for boiler. Laying 800′ stoneware pipe line and building delivery tank.
Ghotawda	... ...	Overhauling and cleaning the engine and pump, refixing of new suction and delivery piping.

Skilled Men.

Engineers skilled in erection work such as this Department requires are very hard to obtain. Likewise skilled coolies on small pay who can manage and run oil engines successfully are almost an impossibility. I have for this purpose engaged a few boys who are being trained in this particular class of work, and eventually hope to be able to offer their services to power plant owners.

Inspection and Survey Tours.

Most rapid touring was necessary to compete with the rush of enquiries, as I wished to visit all sites personally, the owners of which had applied for help in fixing power machinery. Many trips were made especially for inspecting the work of the steam plough. On account of the work on hand and the rapid touring I have not been able to survey every site as minutely as I should like to have done.

Help rendered at the time of breakages.

When cultivators apply to me for repairs I invariably respond especially in deserving cases. My object is to dispense with the fear which at present exists in the minds of these men, *viz.*, breakdown and failure.

Staff and Establishment.

I have receiyed zealous assistance from my staff during the year which has been a very busy one. We have all been working at top speed and the present staff is becoming inadequate to deal with the increasing amount of work.

I make special mention of my Assistant Mr. C. G. Paranjpe who has done justice to the work given him. He is readily taking to the duties of an Agricultural Engineer.

Mr. Talegaonkar who was placed in charge of the Steam Plough after the departure of the European Ploughman did justice to the responsibility placed on him and credit is due to him for his able work.

Messrs. Vaidya, Pednekar, Kanetkar, Khadilkar, Rahatar and Tambe have done good erection work and are now useful men to the Department.

Mr. Khadilkar S. V. has given satisfaction in his capacity as a draughtsman.

Mr. Joshi has again proved himself to be a capable and painstaking Head Clerk and is a man in whom I have the utmost confidence.

Mr. Utgi is rapidly becoming efficient as an Account Clerk.

Tagávi.

Many enquiries from cultivators have been received asking whether machinery can be had on the instalment plan. Having regard to this matter I have enquired of the firms in Bombay but find that they are not in favour of this system of selling. For general information I may state that Government grant tagávi to deserving cultivators on my recommendation for the purchase of machinery, providing they can offer sufficient security. This tagávi is repaid by instalments and interest is charged for the use of this money at 6¼ per cent.

Workshop.

The workshop buildings are in progress and will be ready sometime this year. Although the building is not complete, during the year, four cultivators have been trained in the practical handling of Power Pumping Machinery. I examined them and found that in each case they had readily grasped the fundamentals necessary for the successful running of pumping plants.

Broadly speaking the policy adopted by my Department is to advise and assist those who have some sense of self-help and of business like methods; and to prevent their purchasing unsuitable machinery. It is of no use for a man to have machinery unless he has some intelligence and a good deal of industry, where I am convinced these conditions are lacking I never recommend the purchase of a plant.

LITERATURE.

Articles are periodically published in "The Poona Agricultural College Magazine" and "Shetaki and Shetkari Magazines" in which are described the various Engineering problems met with in India, and the methods found best by experience of coping with them.

The articles are printed in English, Maráthi and Kánarese.

During the year under report many enquiries have been received as a result of these publications.

W. M. SCHUTTE,
Agricultural Engineer,
Bombay Presidency, Poona.

Statement showing cost of irrigation by power.

Index letter.	Name of District.	Average lift in feet.	Numbers of acres irrigated.	Nature of crops.	B. H. P. of Engine.	Size of pump.	Annual expenses per acre per annum.	Remarks.
							Rs. a. p.	
A	Dhárwár ...	45	15	Sugarcane ...	6½	2½"	84 6 6	
B	Belgaum ...	30	20	Sugarcane ...	6½	3"	59 4 9	
C	Jalgaon ...	37	15	Sugarcane ...	6½	2½"	84 9 7	
D	Sátára ...	36	20	Sugarcane ...	10	3"	100 12 9	In this plant two pumps are taken into consideration owing to the great difference in the lowest and highest water levels.
E	Sholápur ...	40	20	Sugarcane ...	8	3"	75 11 3	

W. M. SCHUTTE,
Agricultural Engineer, Poona.

Statement showing cost of irrigation by Mhotes.

Index letter.	Name of District.	Average lift in feet.	Numbers of acres irrigated.	Nature of crops.	Number of Mhotes.	Numbers of bullocks.	Annual expenses per acre per annum.	Remarks.
							Rs. a. p.	
A	Dhárwár ...	45	2	Sugarcane ...	1	4	312 0 0	
B	Belgaum ...	30	2	Sugarcane ...	1	2	127 8 0	
C	Jalgaon ...	37	2	Sugarcane ...	1	2	140 0 0	
D	Sátára ...	36	2	Sugarcane ...	1	2	250 0 0	
E	Sholápur ...	40	2	Sugarcane ...	1	4	107 0 0	

W. M. SCHUTTE,
Agricultural Engineer, Poona.

Statement showing efficiency and economy of the power-crusher over the Poona Mill, both worked at Gokák Canal Farm in 1913-1914.

Power-crusher. Daily working expenses.	Amount.	Poona Mill. Daily working expenses.	Amount.
	Rs. a. p.		Rs. a. p.
Engine-driver at Rs. 15 per month ...	0 8 0	Four coolies at 6 as. a day (two coolies to bring cane and remove juice and megass and 2 feeders).	1 8 0
A boy to assist the driver at 4 as. a day ...	0 4 0		
Four men at 6 as. per day (2 to bring cane and 2 to feed).	1 8 0	Four pairs of bullocks with drivers at Re. 1 per pair including driver.	4 0 0
One boy to remove megass at 2 as. per day.	0 2 0	Lubricating oil per day	0 1 0
Rock oil	2 12 0	Kerosene oil for lamp at night ...	0 0 6
Lubricating oil for engine and crusher ...	0 10 0		
	5 12 0		5 9 6
Depreciation on engine and crusher ...	2 10 10	Depreciation on the mill ...	0 1 10½
Interest on outlay of Rs. 6,425	3 3 4	Interest on Rs. 140 cost of the mill ...	0 1 1½
Incidental expenditure per day	0 2 8	Incidental expenditure per day ...	0 0 2
	11 12 10		5 12 8

Note.—In one day of 10 hours, 12 pans of juice can be extracted for Rs. 11-12-10, *i. e.*, one pan costs Re. 0-15-8. Therefore a saving of Re. 0-7-6 per pan is effected by use of power-crusher.

Note.—In one day of 10 hours, 4 pans of juice can be extracted for Rs. 5-12-8, *i. e.*, one pan costs Rs. 1-7-2, or Re. 0-7-6 per pan in excess of the power-crusher.

Note.—Besides there is a higher percentage of extraction by power-crusher of 5 per cent. over the Poona Mill which means that we get 13½ lbs. more gul per pan, which will realize Re. 0-13-6.

So that the net saving _____ effected by power-crusher amounts to Rs. 1-5-0 per pan, *i. e.*, in other words Rs. 15-12-0 per day over the Poona Mill.

W. M. SCHUTTE,
Agricultural Engineer, Poona.

Report on the working of the Steam Plough.

1. *Introductory.*

(1) The introduction of Steam Plough into the Dharwar District is the outcome of a long deliberation and discussion. Experiments with the Bajac Co.'s bullock gear plough have shown that ploughing to a depth of 16″ eradicates harali and other deep rooted weeds, but the process with this plough is slow and expensive, probably only slightly cheaper than the local method of digging by hand labour. However, requiring as it does much less supervision, it is the much more convenient method. 30-40 acres, in a season at a cost to the land-owner of Rs. 35 per acre, means slow progress at an expense which few can afford to incur. The fact that the cultivator employs this plough rather than hand labour seems to be largely accounted for by the beneficial effect on the tilth, quite apart from the destruction of the weeds. His own method leaves the land uneven, and the succeeding crop is very irregular. The experiments with the Bajac plough cleared the way for experiment with steam power. Any doubts on the utility of deep ploughing were effaced. The economy of effecting it by steam power was still to be tested.

(2) In the black soil tracts of the South Deccan Bombay especially along the eastern border of the Mallad tract, harali and kunda have gained possession of a very large portion of land. The few who employ hand labour to dig the weeds have made but small progress.

(3) Accordingly the Board of Trustees of Sir Sassoon David Trust Fund were approached with a scheme, and kindly decided to provide funds for the purchase of a double engine steam ploughing plant, this plant to be taken to Ranebennur district, Dharwar, for its first year's work. The plant consisted of—

(4) Two Class K Compound ploughing engines with enlarged fire-boxes, tanks to let down at back, hind road wheel 6′-6″ diameter and 18″ wide. Awnings over foot-plates, injectors and connections, etc., complete. Each engine fitted with 450 yds. of Fowler's specially selected best plough steel wire rope, 24 wires langs twist with thimbles, one 3 Furrow Zigzag balance plough fitted with steel skifes 29″ deep under beam, steel mould boards, etc., with outfit complete. One 9-11 Tyne Patent Turning Cultivator with steel tynes 10″ centres, patent self-acting lifting gear for cleaning tynes and ordinary lifting gear for turning at ends, complete with outfit. One-5 Flat High Frame Harrow mounted on W. I. wheels complete with poles, chains and harrow flats, fitted with drum lifting gear complete with outfit. Two 4 Wheeled Water Carts with barrels 6′ long × 3′ dia. with hand pumps and wire-bound suction pipe and delivery pipe complete with dragbar.

(5) The Trustees in their agreement stated that if the plant was successful the amount realized as profit was to be paid into the fund towards the capital; no mention was made of interest. However, it will be seen that in the balance sheet interest is shown which in addition to the actual profit of Rs. 607-5-7 amounts to Rs. 3,037-5-7, an amount which is actually a realization according to their stipulation.

(6) The actual profit on next year's work should be considerably in advance of that on this season's work, provided the precautions which are suggested in this report be observed next year.

2. *Objects of the Report.*

(7) The object of this report is to describe the working of the steam plough at Ranebennur during its first season November 1st—May 15th; to compare estimates and actuals; to offer criticisms on the work; to state the results as far as possible at so early a stage and to offer suggestions for the future.

(8) During the first season's work it is natural that obstacles occurred which could not be foreseen while drawing up an estimate. With a double shift the loss on account of time wasted was considerable. Every hour during which the plant was at rest meant loss in acreage ploughed and a heavy labour charge expended without result.

(9) The effect of the ploughing on the tilth and the crops will be dealt with in a supplementary report to be issued later.

3. *Brief Chronological Account.*

(10) The tackle arrived at Ranebennur in September and through the courtesy of the M. & S. M. Railway Company was erected in the station yard during the next few weeks. Prior to this a canvasser had been at work for some months registering orders and preparing a plan of campaign. Visits to various villages in the neighbourhood of Ranebennur resulted in the selection of six as a field of work. Deep black soil, infested with harali (Cyndon Dactylon), was naturally the criterion for selection. Some submitted their applications voluntarily, some under suasion by the canvasser, generally subject to the proviso "If tagavi loan is granted." They found that they had nothing to fear on this account.

(11) The land secured was finally divided into blocks of adjoining fields, and each was given a serial number, the series indicating the order of succession in which the plough was to visit the blocks. Throughout the preparation of the scheme, the foremost aim was to reduce to a minimum the time required for removing the tackle from place to place. All land

booked for ploughing was left fallow or sown with jowar, and an undertaking to this effect was required from each applicant. A certain amount of pressure was necessary to enforce this condition, and the names of a few who sowed their lands with cotton, were finally struck off the list; those whose fields came at the head of the list undertook to harvest jowar green, if necessary, and to have all clear for ploughing by November 1st.

(12) As soon as the engines were assembled and tested, a preliminary trial was given in a field kindly lent by the Hon. Rao Sahib V. S. Naik, and the men were given a few days practice before starting on the serious work of the year on November 2nd at the village of Halgeri, five miles west of Ranebennur. The monsoon season was one of light rainfall, and the land was in a fair condition for ploughing, though in the opinion of many so wet that harali would grow again excessively, an opinion which later observation shows to be untenable; there is, it is true, a slight growth of the grass, but not so serious that it could not be destroyed for about Rs. 1 per acre.

(13) Work progressed smoothly, but at first very slowly raw men had to be trained, a single staff to be rendered fairly efficient before a second could be brought into training. After one month, however, on December 2nd the double shift was at work, and the engines were running from daylight to dark, but it was some time before the double shift was really competent and able to plough efficiently, although they took to the work readily.

(14) Earlier than this, His Excellency the Governor had paid a visit to the site; on that occasion, and the two or three succeeding days, a constant stream of visitors testified to the interest which was being taken by the public.

(15) The ploughing in Halgeri was completed on 13th January 1914 and subsequently the villages of Hullati, Guddad-Anveri and Shridhan-Hal provided work for the rest of the season. The area originally estimated for was not covered, and on completion of a programme revised about two months previously, work was stopped on April 28th, 1914.

(16) Details regarding the organisation are given in the discussion of the various heads of account which follow, weaknesses are pointed out and remedies suggested.

4. Balance Sheet.

(17) For account purposes the year has been taken as ending on May 15th. The actual ploughing season commenced on November 2nd and ended on 28th April. It is risky to estimate for a ploughing season beginning on November 1st. Jowar is still standing and in a year of normal rainfall if the land is to be cleared, this crop must be harvested green naturally at considerable loss. The land is liable to be very wet. November 15th is therefore a safe date on which to base estimates.

(18) The balance shows a net profit of Rs. 607-5-7 after paying interest on capital at 6 per cent. The writers under the circumstances consider it satisfactory to have cleared expenses in this the first year of work. An amount of Rs. 1,168 is to be invested each year as a sinking fund which is allowing for a 10 per cent. depreciation 8 months of the year. In taking this figure it is assumed that at the end of 20 years the machinery is only worth 5 per cent. of its original value, or, in other words scrap iron value. Judging from the exacting nature of steam ploughing which to be done efficiently necessitates the tackle being kept in through repair, the figure of 5 per cent. is certainly a modest one. It may be considered by some that 20 years is too long a period for the life of the plant but there is absolutely no reason why it should not work 30 years.

(19) The receipts were realised partly at Rs. 17-8-0 per acre and partly at Rs. 21 per acre details will be found under "Receipts and acreage ploughed." There seems to be no occasion to charge the smaller fee during the early part of the season and the rate of Rs. 21 per acre throughout is suggested for the future. (Statements of accounts attached.)

5. Staff.

(20) The staff employed consisted of an Engineer in charge of the tackle on Rs. 75 and a canvasser on Rs. 35. The former officer's salary is charged to the Steam Plough for 7 months only; he is employed elsewhere during the remainder of the year. The canvasser's salary is charged for the full 12 months, and he is engaged for half the year in canvassing, and for the other half in keeping accounts and controlling labour other than that actually employed on the tackle.

(21) A European ploughman from Messrs. John Fowler & Co. took charge for 5 months, and trained the men. His salary is included in capital expenditure.

(22) To prevent any serious mishap when this European ploughman was withdrawn, arrangements were made for a Government Engineer to work with him from the commencement. He assisted with the erection of the tackle and afterwards was instructed in the management of the plough. It is gratifying that this arrangement is proving satisfactory.

6. Labour and Repairs.

(23) The total cost of labour on the tackle amounted to Rs. 1,676-3-6 and of this amount Rs. 1,403-5-0 have been apportioned as efficient and Rs. 272-14-6 as non-efficient.

The non-efficient labour is debitable partly to repairs and partly to haulage of water and coal. Rs. 248-3-9 are debited to repairs; this figure includes materials used and miscellenous charges apart from labour. The ledger shows Rs. 17-12-6 under petty repairs and Rs. 230-7-8 under incidental charges. The latter are charges of recurring nature, not strictly classifiable as repairs but directly connected with the maintenance of the tackle. Purchase of Shindi baskets, ropes, and buckets are amongst the items included. Strictly speaking the repair bill should show only Rs. 17-12-6 plus labour charges; this being so, a separate item of incidental charges Rs. 230-7-3 would appear in the balance sheet.

(24) The monthly labour bill when the plant was in full swing after the men were trained and after the double staff was complete, amounted to about Rs. 262-8-0. The number of units employed were 14 including—

	Rs.	a.	p.
2 Drivers on Rs. 50	100	0	0
1 Driver on Rs. 24	24	0	0
1 Driver on Rs. 22-8-0	22	8	0
2 Oilmen at Rs. 12	24	0	0
2 Oilmen at Rs. 10	20	0	0
2 Ploughmen at Rs. 12	24	0	0
2 Ploughmen at Rs. 10	20	0	0
1 Driver in training on Rs. 20	20	0	0
1 Fireman on Rs. 8	8	0	9
	262	8	0

7. Haulage of Coal and Water.

(25) Under these two heads, a total expenditure Rs. 1,987-8-10 was incurred. This charge is very high. Cartage was done entirely with hired carts and bullocks, and was carried out well for a time, but the bullock owners were not long in realising that their's was a position of advantage. They demanded higher pay and less work, and closed finally with an offer of Rs. 45 per cart with driver and two bullocks per mensem. Three water carts were necessary for each shift except on a few occasions when the water supply was close at hand. Each cart was fitted with two empty oil barrels, and carried about a 100 gallons each journey. This meant six men and 12 bullocks permanently employed at a total monthly cost of Rs. 260-270, in order to supply the engines with 2,500 gallons of water per day. The water carts sent with the tackle are of no use in India. Attempts were made with the bullocks available, but they were hardly strong enough to haul the carts along the roads, let alone across the fields. Small carts therefore had to be constructed to carry on the work. The total debit for water amounted to Rs. 1,335-12-1 apart from cost of the employment of hired carts was most unsatisfactory. The men were extremely independent, and unpunctual, and required an amount of supervision which it was not always possible to give. The result was that the engines were kept standing for want of water much too frequently.

(26) The figure of Rs. 631-12-9 for haulage of coal includes both manual labour for unloading and carting charges. The cost of delivering 211 tons of coal at points varying between 3 and 6 miles from railway station was Rs. 631-12-9 or an average cost of Rs. 3 per ton. The total cost of coal per ton delivered into the engine bunkers was Rs. 28, a very serious item especially when it is not possible to make the utmost of it by converting into useful work.

(27) The question of haulage during the next season's work has received detailed attention by the writers of this report, and they have come to the conclusion that it will be advisable either to purchase bullocks and to employ drivers permanently, or as an alternative to purchase a small motor having two detachable trailers which can be used both for water and coal. By the latter means the tackle can be kept fully employed and a great saving realised. Estimates for each system are given below :—

Estimate for steam tractor.

	Rs.	a.	p.
Cost of steam tractor	7,605	0	0
Cost of trailer with steel wheels	1,890	0	0
Cost of tank for water	350	0	0
	9,845	0	0

Yearly Expenditure.

	Rs.	a.	p.
Interest per annum 6 per cent. on the capital	590	11	2
Sinking fund for depreciation	283	13	9
Repairs for 6 months	246	2	0
Driver's wages Rs. 30 per month for 5 months	150	0	0
Oilman's and Coalman's wages for 5 months at Rs. 10 each...	100	0	0
Cost of coal Rs. 5 per day for 130 working days ...	650	0	0
Cost of lubricating oil waste and sundries for 130 days ...	100	0	0
	2,120	10	11

The estimate for bullock traction given below is based on the assumption that the bullocks are kept the whole year and that their whole cost is to be charged to the plough.

Initial Expenditure.

	Rs.	a.	p.
Purchase of 7 pairs of bullocks at Rs. 300	2,100	0	0
Purchase of 3 water carts at Rs. 200	600	0	0
Purchase of 3 carts for coal at Rs. 55	165	0	0
	2,865	0	0

Annual recurring expenditure.

	Rs.	a.	p.
Feeding charges	1,176	0	0
7 men at Rs. 10	840	0	0
Interest at 6 per cent	175	0	0
Depreciation on live-stock 10 per cent.	210	0	0
Depreciation on water carts 5 per cent.	30	0	0
Depreciation on coal carts 15 per cent.	24	12	0
	2,455	12	0

These figures do not compare well with those given for the tractor, but apart from cost it would be very much less convenient to employ bullocks. Risk has not been allowed for in the above estimate; there would be 7 men requiring supervision. The suggestion to purchase bullocks at the beginning of the season and to sell them at the end is quite impracticable, apart from the fact that a special man would have to be employed to do the buying and selling. If they are not sold, it would be difficult to find work for them during the monsoon. Apart from haulage water was a constant source of trouble throughout. It contained a high percentage of salts and gave the following analysis kindly furnished by the Agricultural Chemist :—

	Well Water Sample, Parts per 10,000.
Total soluble salts	158·00
Sodium Carbonate	2·96
Calcium Carbonate	16·00
Magnesium Carbonate	21·86
Sodium Bicarbonate	28·17
Sodium Sulphate	4·26
Sodium Chloride	78·41

The water formed a crust and was continually giving trouble. It caused excessive priming when the engines were working and consequently the deposit had to be blown off repeatedly which meant many stoppages with the tackle and much loss of fuel. Every care, however, was excercised to prevent undue incrustation and a suitable reagent was discovered in "Boilerine." On examination at the end of the season the internal plates were found to be quite free from scale.

(29) Next season an analysis of the proposed feed water will be made and a suitable reagent introduced immediately, consequently future trouble under this head will be dispensed with.

8. Consumption of Coal.

(30) The total consumption of coal was 211 tons 13 cwts. at a cost of Rs. 5,292 delivered at Ranebennur station. Herein lies the greatest objection to steam cultivation in India, the exhorbitant cost of coal, which is largely accounted for by railway freight, in the present case amounted to Rs. 16 in every Rs. 25. During the first two months work the fact that the men were new to the tackle meant an unnecessarily large consumption of coal per acre.

9. Receipts and Acreage Ploughed.

(31) The total receipts amounted to Rs. 15,198-13-8 for 770·18 acres ploughed. The rate charged during the months of November and December to 14th January was Rs. 17-8-0 per acre and 280·12 acres realised Rs. 4,905-4-0. During the remainder of the season Rs. 10,293-9-8 were received on account of 490·6 acres ploughed at Rs. 21. These figures fall considerably below those estimated. Due allowance was not made for the slow progress inevitable while working with untrained men. It was not possible to get into full swing with a double shift of practised men before 2nd December. A 14 hours day is impossible to realize and largely for this reason the estimate of 8 acres a day is in excess of the actual. The average number of acres ploughed per working day was in reality 5·769, the number of working days 133½, but there is every reason to believe that this figure may be increased.

(32) With regular water supply assured by means of the steam traction system, and the delay caused by bad water much reduced a working year of 130 days at an average rate of acres 7 per day could probably be realized.

(33) Receipts in the form of tagavi amounted to Rs. 11,405-12-0 and as cash Rs. 3,793-1-8. The tagavi was drawn according to the original estimate on seperate cheques payable to each individual. These totaled Rs. 14,459 of which Rs. 3,053 were credited to the Treasury after the area ploughed had been actually measured. Procedure will be very much simplified in the future if the estimated amount can be drawn in lump sum and the balance, if any, recredited at the close of the season.

(34) The season's work has shown that next year's efforts must be concentrated on reducing the number of stoppages to a minimum. The organisation adopted for the haulage of coal and water was unsatisfactory and was chiefly responsible for stoppages: for this reason the tackle was held up for 77 hours which means a loss in receipts of Rs. 808-8-0; at the same time the staff were standing idle and their pay was being met without any return:—coal was being consumed and steam escaping to waste. Unpunctual delivery of coal acoounted for a loss of 23 hours or Rs. 241-8-0 in receipts. These items together with the amount paid for the haulage of coal and water equal Rs. 3,017-8-10. Unfortunately this amouut does not cover the total loss. There is a certain wastage in addition to which the direct result of stopping tackle of this description when working at full speed. Men are compelled to stand about and even when water is brought they are not able to pick up the work as readily as it is put down, quite apart from that steam which has been generated during a heavy pull is blown to waste through the safety-valve. Moreover a fresh supply of fuel is required to keep up steam whilst waiting, in other words the swing of the work is temporarily lost and cannot be regained immediately, hence the wastage. During the season under report it is estimated that the loss referred to amounts to Rs. 200. The total loss under haulage head then equals Rs. 3,217-8-10.

10. General Remarks.

(35) As far as can be judged at so early a stage the plough has done really efficient work. The land has been turned up to a depth of 16″ and the root-layer of the harali well exposed to drying. There can be little doubt that in land ploughed since mid-December practically all the grass has died. That ploughed earlier in November and earlier December shows a few green shoots which require a little attention. The real test will of course be an inspection after the monsoon, when apart from weed killing it will be possible to judge of the effect on soil and crop.

(36) The land holder is, it is believed, unanimously of the opinion that the work is good. Adverse critics have appeared on the scene but none recently, and if they still hold their former opinion, they are only the exception which proves the rule.

(37) The cultivator must, of course, realize that steam ploughing is not claimed to be a final operation for the destruction of weeds; but that a very small annual expenditure will certainly keep them under control after deep ploughing has been effected.

(38) The true value of the machinery to the land-holder and to the capitalist will be better deduced after next year's work. This has been a year of experiment in management Next year with a trained staff, and with improvements introduced as the result of the experiments, there seem little doubt that a good profit will be shown on the year's working.

(Signed) T. GILBERT,
Deputy Director of Agriculture,
Southern Division,
Dhárwár.

(Signed) W. M. SCHUTTE,
Agricultural Engineer,
Bombay Presidency,
Poona.

True Copy,
(Signed) W. M. SCHUTTE,
Agricultural Engineer, Poona.

Balance sheet of the working of the Steam Tackle at Ranebennur for the year ending 15th May 1914.

Dr. *Cr.*

Particulars.	Amount.	Particulars.	Amount.
	Rs. a. p.		Rs. a. p.
Capital	40,500 0 0	Plant	40,500 0 0
Interest	2,430 0 0		
Temporary repairs ...	248 3 9	*Stores on Hand.*	
Haulage of coal	631 12 9		
Haulage of water ...	1,335 12 1	Coal	164 0 0
Sinking fund for depreciation...	1,168 0 0	Stores	387 2 0
Dead Stock	69 9 7	Stock	44 15 0
Fuel wood	323 11 0	Recoveries	15,198 13 8
Fuel Coal	5,456 4 0		
Stores	1,002 13 9		
Establishment	845 2 8		
Efficient labour on tackle ...	1,403 5 0		
Nonefficient labour on tackle ...	272 14 6		
Balance by Profit ...	607 5 7		
Total ...	56,294 14 8	Total ...	56,294 14 8

(Signed) T. GILBERT,
Deputy Director of Agriculture,
Southern Division,
Dhárwár.

(Signed) W. M. SCHUTTE,
Agricultural Engineer,
Bombay Presidency,
Poona.

True Copy.

W. M. SCHUTTE,

Agricultural Engineer, Poona.

Boring.

Until the invention of Musto's patent machine the Agricultural Department carried on boring in soil and soft strata only, and operations were confined to Gujarát. The machine employed was the Cawnpore tool which has done really good work since 1907. Many wells by means of this machine have had their supply augmented considerably, in some cases to the extent of 10 and 12 koses. The Deputy Directory of Agriculture during the famine year of 1911 had plenty of scope in this direction. Now with the aid of Musto's patent, boring is possible in trap rock so common in the Deccan tract.

Work Increased.

In 1911 the work assumed such proportion that it was thought advisable to hand over its management to an officer having engineering qualifications who should improve the method of working and increase the efficiency of the apparatus. This was accordingly done in October 1912 and many improvements would probably have been effected had the work been kept under the control of the Agricultural Department, but owing to the transfer of boring to Kaira Local Board this department was not able to make much progress. The boring section of the Department were simply casting about for cultivators who would undertake boring, provided it was outside Kaira District, and although all the surrounding districts were canvassed, very little boring was done.

Mr. Chukerbutty, who was Collector of Kaira at this time, also experienced difficulties and found that the cultivators were not keen on boring when conducted on strict business lines. It was, therefore, decided after Mr. Chukerbutty's transfer to again hand over Kaira boring to the Agricultural Department; accordingly arrangements were made and I took charge of operations in May last.

Kaira, the Centre of Boring.

Much confusion seems to have been the result of this transfer and it is hoped steady progress will now result in having boring done under more favourable rules and by a Department specially trained for the work.

The boring conducted by this Department is principally for irrigation purposes; the cultivators, however, do not hesitate to use it for drinking purposes provided the water is sweet. Undoubtedly this is source of supply infinitely better than the village tank, a slime covered muddy depression filled with highly discoloured and offensive liquid, in which the buffaloes wallow, clothes are washed, the villagers bathe, and use for drinking and cooking purposes.

Change of Rules.

Rules much better suited to the Indian ryat are now in force and the old system of enforcing strict commercial principles abolished.

Suitable Circumstances.

Nearly all the adverse circumstances to the growth of boring operations have been removed, and I anticipate excellent results in consequence.

New Tools on Hand.

There are now in the Department 44 boring machines consisting of one Petrol Power Borer capable of boring to a depth of 500 to 1,000 feet; one Calyx Hand Borer capable of boring to a depth of 200 feet; 13 Musto Patent Boring machines also capable of boring to a depth of 200 feet and 29 sets of the Cawnpore type of Borer which can bore to a depth of 200 feet in soil only; all the former machines can bore either in soil or rock.

Boring Campaign.

With these machines and a specially trained staff I am quite ready for a boring campaign, the result of which I anticipate will supply the Department with some very useful data, apart from the fact that the cultivators will in many cases have a good supply of water.

Administration of the Boring Operations in Gujarát.

Mr. Nagindas who worked as an Overseer for five years has recently reverted to the Public Works Department. His successor Mr. Mehta was appointed temporarily until the Kaira boring was handed over to my charge. At the time of this transfer it was agreed to engage the Kaira Boring Overseer provided I considered him suitable. This was done and Mr. Mehta reverted to the Non-graduate staff on Nadiad Government Farm. Mr. Gulabsingh, the Assistant Overseer, was placed in charge of boring operations in Gujarát and Mr. Chitle, who was appointed to fill the temporary post of Boring Overseer, Bombay Presidency, set up his quarters at Poona.

Hitherto boring operations were strictly confined to Gujarát, but since the introduction of the new machine operations have extended over a greater part of the Presidency, and it was considered advisable to have the head-quarters in Poona.

Rock Boring in Gujarát.

As we have now three Musto's patent machines in Gujarát, I shall be able to tackle such rocky portions as exist in Broach, Surat and Panch Mahâls Districts.

Boring in the Deccan.

Boring in Deccan is a new industry, and until quite recently has not been taken up with any degree of interest in the Deccan. My experience during the last fair season, however, proves that rock boring is not only possible but practicable as the following will prove.

Particulars of Bores taken.

I commenced rock boring operations last January and Sholápur was the first district selected. These operations were extremely important at the time owing to the severe state of famine in the district.

Two Holes at Mardi.

The first two bores were taken by this Department in a well at Mardi, a village 7 miles from Sholápur. The well is situated near the village and is dry. The bores were taken from the bottom and the strata encountered was trap.

Water was struck at a depth of 43 feet from the surface, but was only very feeble and after boring to a depth of 60 feet operations were abandoned.

Water-finder.

It was decided about this time to put the Mansfield water-finder (in charge of Dr. Mann) to a practical test, accordingly arrangements were made as far as practicable to bore only where indications had previously been given by this instrument.

The first indication was tested in a well belonging to the Warad Estate in Sholápur.

Warad's Well.

A machine was erected at this well and a bore was taken at a place indicated by the water-finder; at 69 feet from the surface, or 19 feet from the bottom of the well water was struck, rose 19 feet, and flowed into the well: as a result of this bore 1,500 gallons of water per hour were pumped continuously for 3 hours in addition to the former supply. In other words before boring a mhote worked 3 hours a week, and after boring a mhote could work 3 hours daily.

The work is still in progress and I believe there are many wells in the Deccan which could give a similar and even better results.

Well in Karmála Ginning Factory.

Another bore was made in a well at Karmála, Sholápur District. At a depth of 52′-6″ water was struck and rose 9 feet up the bore. A 2″ semi-rotary pump was fixed to test the supply. The pump delivered 1,500 gallons an hour *i. e.* equal to one mhote. The water level could not be lowered however, although the pump was worked for 8 hours continuously. The supply is certainly a good one, moreover it is continuous and the water is potable.

Whilst boring was in progress drinking water was sold at one anna per ghada, which had to be carried a distance of 3 miles and was really filthy stuff, but as this was the only supply, the people drank it. However, when water was struck and pumping operations commenced the whole village turned out with their drinking vessels, and through the kindness of the owner had free access to the water, such a supply was indeed a boon to this famine; striken area. Previous to boring the water-finder had given strong indications of a current at this particular spot.

Pangri Well.

A third bore is in progress at Pangri.

Temburni Well.

A fourth bore is being made at Temburni, where indications have been given by the water-finder.

It will perhaps be advisable at this stage to state that most of these bore holes are only 3″ in diameter, and that when a hole of this diameter is made 100 feet deep it contains approximately 30.5 gallons, so that if we can get 1,500 gallons per hour similar to the case at Karmála from a hole 3″ in diameter and 17′-6″ deep with a water level 8 feet from the surface, it means that by far a greater part of this supply is simply running through the rock into the bore-hole.

As a result of the first enquiry in Poona a bore was taken in Sir D. J. Tata's compound, after 10 days work a hole 50 feet deep 3″ diameter was made, whilst boring and at a depth of 35 feet water was struck, this level being maintained until the completion of the bore and although the strata encountered was trap, pumping operations revealed the fact that 266 gallons could be obtained continuously for 8 hours each day. The water is potable.

A similar bore was taken in Mr. Narayandas Dwarkadas's compound to a depth of 202 feet. Here trap was encountered at a depth of 195 feet and then changed into crystalline trap which continued to 200′. At this depth again rock made its appearance. Water was tapped at a depth of 56 feet from the surface and rose 28′-6″ in the hole. A 1½″ semi-rotary pump was fixed and worked continuously for 8 hours without any water depression. It is obvious that an equivalent amount to the mhotes capacity can be pumped from this bore when a suitable pump is fixed.

Bores on Ganeshkhind Roads.

One bore is in progress on Ganeshkhind road where prevlous indications have been given by the Mansfield Water-Finder. The bore is at present 182 feet and it is interesting to note that until a depth of 90′ was reached no water was found; at that depth however water was struck and rose 30 feet giving a continuous supply of 120 gallons per hour. The water is potable and was tapped during the last week in May.

During the year under report 13 bores have been made in the Deccan and 10 are in progress. This is not a brilliant result, but it must be remembered that men totally unused to boring have had to be trained to work the machines, and although it is quite possible to bore from 6 to 7 feet per day, owing to the scarcity of suitable men only 3 feet per day have actually been accomplished. Now the men are becoming efficient, a much better result is possible.

Sticking of Tools.

This was a great difficulty and at first very discouraging; but after strenous efforts I was able to show the men how to keep the tool uniform in shape and to the correct hardness which is absolutely essential to ensure a true and perpendicular hole in rock.

Cultivators Benefitted.

The new rules apply equally well to rock boring and as a result of their destribution to deserving cultivators boring is being taken up with alacrity and I am satisfied that with the men and machines now available I shall be able to accomplish some very useful work.

Men Trained in Handling Musto's Patent.

In addition to the Departmental Muccadams, District and Táluka Local Board Overseers and mechanical engineers from states and firms have been trained in erecting, dismantling and working the Musto patents. Some of the Local Boards and Native States I understand have purchased machines for their own particular use.

Enquiries for Boring.

During the year under report 169 enquiries have been received from various parts of the Presidency on the subject of boring.

Staff and Establishment.

I have pleasure in stating that my Boring Overseer Mr. Chitle has rendered me invaluable help in conducting the work of this section of the Department.

Line of work for next year.

Next fair season a boring campaign will be conducted in all the principal districts of the Presidency. Special attention is to be given to the area between Gokák and Bágalkot where it is assumed the strata consists of trap, laterite, alluvium and inter-trappean beds.

It is hoped some very useful data will be available at the close of this campaign.

A statement giving full particulars of some typical bores taken is attached for general information on this subject.

W. M. SCHUTTE,
Agricultural Engineer,
Bombay Presidency,
Poona.

Statement of wells bored in the Bombay Presidency from 1st July 1913 to 30th June 1914 with particulars as to the water-supply, cost per foot of boring, percentage of successes, etc.

Serial Number.	Táluka.	Village.	Depth and particulars to the commencement of boring.	Total depth of boring.	Depth of water bearing stratum from ground level.	Total labour charges.	Average labour charges.	Cost of pipes and miscellaneous charges.	Total charges.	Average expenditure per foot of boring.	Water after boring.	Percentage of successes.	Remarks.
1	2	3	4	5	6	7	8	9	10	11	12	13	14
			Ft. in.	Ft. in.	Ft. in.	Rs. a. p.	Rs. a. p.	Rs. a. p.	Rs. a. p.	Rs. a. p.			
	Ahmedabad District.												
1	South Dáskroi.	Kabudthal ...	Well 55 0	94 0	157 0	201 0 0	2 2 3	127 9 4	328 9 4	3 8 0	2 Koses ...		Sweet water is tapped.
2	Do. ...	Do. ...	Well 47 0	150 8	192 0	203 7 0	1 5 6	165 8 2	368 15 6	2 7 3	2 Koses ...		Do.
3	Do. ...	Do. ...	Well 42 0	84 0	Nil.	129 4 6	1 8 7	89 2 2	218 6 8	2 9 6	Nil ...		Unsuccessful as the supply is small and brakish.
4	Do. ...	Wabelal ...	Well 42 6	64 6	101 0	48 10 0	0 12 0	72 7 9	121 1 9	3 8 2	4 Koses ...		Sweet water is tapped.
5	Do. ...	Do. ...	Well 59 0	51 0	103 0	40 2 0	0 12 6	48 0 6	88 2 6	1 11 8	2 Koses ...		Do.
6	Do. ...	Jhanu ...	Well 44 0	64 0	Nil.	233 9 0	3 10 2	100 15 7	334 8 7	5 3 7	Nil ...		Unsuccessful.
7	Do. ...	Lálpur ...	Well 33 0	57 0	85 0	159 2 0	2 9 10	79 14 10	239 0 10	4 3 1	½ Kose ...		Sweet water.
8	Do. ...	Hooka ...	Well 62 0	67 0	117 6	36 14 0	0 8 10	72 3 9	109 1 9	1 10 1	3 Koses ...		Do.
9	Dholka ...	Dholka ...	.....	...	...	...	...	.....	.....	...	.....		Unsuccessful.
10	Virámgaon ...	Virámgaon ...	.....	...	...	...	...	.....	.....	...	.....		Left incomplete owing to want of coolies.
	Surat District.												
11	Bárdoli ...	Jamnia ...	.....	...	...	...	...	Work in	progress.	...	.....		Result not known as yet.
12	Jaláipur ...	Amalsad ...	.....	...	...	...	...	Do.		...	.....		Do.
13	Do. ...	Kacholi ...	.....	...	...	...	...	.....	.....	...	.....		Unsuccessful owing to mishap of tool.
14	Do. ...	Kharsad ...	Well 45 0	34 6	77 0	22 13 0	0 10 8	37 3 3	60 0 3	1 11 10	1 Kose ...		Sweet water is tapped.
15	Balsár ...	Kundi ...	Well 44 8	4 0	48 8	19 11 0	4 15 0	21 8 9	41 3 9	10 5 0	1 Kose ...		Do.
16	Do. ...	Bhagda (Khurda).	.....	...	...	...	Work	in progress.	.....	...	.....		Result not known yet.
17	Chikli ...	Khaperia ...	Well 44 10	32 0	74 10	44 6 0	0 11 6	47 10 4	92 0 4	2 14 0	1 Kose ...		Sweet water is tapped.
	Broach District.												
18	Jambusar ...	Kareli ...	Well 35 0	48 0	75 0	46 12 0	0 15 3	61 7 2	108 3 2	2 4 1	4 Koses ...		Do. water-level ro 4' in the well.
19	Do. ...	Wadach Bhatha.	Well 30 0	93 0	118 0	62 14 0	0 10 3	112 3 1	175 1 1	1 12 7	6 Koses ...	66·66	
20	Do. ...	Jambusar ...	.....	...	...	...	Work	in progress.	.....	...	.....		Result not known yet.
	Kaira District.												
21	Borsád ...	Vadeli ...	Well 70 0	30 0	100 0	22 12 0	0 10 8	45 1 0	67 13 0	1 15 10	10 Koses ...		Sweet water is tapped.
	East Khándesh District.												
22	Jalgaon ...	Jalgaon ...	Well 48 0	35 0	56 0	Not	known.	.....	.....	...	Successful ...		Sweet water is tapped only sufficient for the farm staff.
23	Do. ...	Do. ...	.....	...	...	...	Work	in progress.	.....	...	.....		
	Poona District.												
24	Haveli ...	Poona ...	Surface ...	93 0	46 0	...	...	.....	Not	known.	250 gallons per hour.		Water was pumped out at the rate of 250 gallons per hour for 8 hours.
25	Do. ...	Do. ...	Ditch 10 0	40 0	25 0	29 4 0	0 11 8	78 14 0	108 2 0	1 3	266 gallons per hour.		Water was pumped out at the rate of 266 gallons per hour without lowering the level for 8 hours.
26	Do. ...	Do. ...	Ditch ...	202 0	56 0	315 0 0	1 8 2	243 11 0	558 11 0	2 12 3	750 gallons per hour.		Water rose within 28' of the surface 1½" semirotary pump was worked continuously for 8 hours without lowering the level.
27	Do. ...	Do. ...	Surface ...	67 2	Nil.	36 0 0	0 8 11	1 0 0	46 0 0	0 11 2	Nil ...		Unsuccessful.
28	Do. ...	Do. ...	Do. ...	62 0	...	60 0 0	0 15 6	10 0 0	70 0 0	1 2 1	Feeble supply.		Hole can be emptied with the sand pump.
29	Do. ...	Do. ...	Dry well 40 0	60 0	Nil.	100 0 0	1 10 8	105 14 0	205 14 0	3 6 0	Nil ...		Unsuccessful.
30	Do. ...	Do. ...	Surface ...	107 0	...	...	Work	in progress.	.....	...	.....		Water was tapped at 90' and rose up to 40' from ground level.

Serial Number.	Tálúka.	Village.	Depth and particulars to the commencement of boring.	Total depth of boring.	Depth of water bearing stratum from ground level.	Total labour charges.	Average labour charges.	Cost of pipes and miscellaneous charges.	Total charges.	Average expenditure per foot of boring.	Water after boring.	Percentage of successes.	Remarks.
1	2	3	4	5	6	7	8	9	10	11	12	13	14
	Sholápur District.		Ft. in.	Ft. in.	Ft. in.	Rs. a. p.	Rs. a. p.	Rs. a. p.	Rs. a. p.	Rs. a. p.			
31	Sholápur ...	Mardi ...	Well 35 0	45 6	Nil.	50 0 0	1 1 7	25 0 0	75 0 0	1 10 8	Nil ...	66·66	Unsuccessful.
32	Do. ...	Do. ...	Do. ...	60 0	Nil	50 0 0	0 13 0	15 0 0	65 0 0	1 1 4	Nil ...		Do.
33	Do. ...	Sholápur ...	Well 45 0	60 5	75 0	27 0 0	0 7 2	111 6 0	138 6 0	2 4 9	375 gallons per hour.		The water is flowing from the hole sufficient to work a mhote for 8 hours a day.
34	Karmála ...	Karmála ...	Well 35 0	20 0	58 0	22 8 0	1 2 0	46 10 0	69 2 0	3 7 8	1,500 gallons per hour.		The water was pumped out at the rate of 1,500 gallons per hour, continuously for 8 hours. The water level rose within 43' of the surface.
35	Do. ...	Tembhurni ...	Surface ...	...	...	...	Work in progress.	.....	.....	...	.....		Result is not known as yet.
36	Bárshi ...	Pángári ...	Well 28 0	...	...	...	Do.	.....	.....	...	.....		Do.
	Thána District.												
37	Sálsette ...	Borivali ...	Well 20 0	...	...	...	Work in progress.	.....	.....	...	.....		Do.
	Kolhápur State.												
38	Kodoli ...	Kodoli ...	Well 30 0	...	...	...	Work in progress.	.....	.....	...	.....		Work stopped owing to heavy rains.

Percentage of successes in Gujarát (Alluvial plains) is 70·56 and in the Deccan (Trap) 61·53.

W. M. SCHUTTE,
Agricultural Engineer, Bombay Presidency,
Poona.

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Annual Reports.

Annual Report of the Department of Agriculture, Bombay Presidency, for the year 1913-14.

No. 2607.

REVENUE DEPARTMENT.

Bombay Castle, 4th March 1915.

Letter from the Director of Agriculture, No. A.—10838, dated 1st December 1914—Submitting the Annual Report of the Department of Agriculture, Bombay Presidency, for the year 1913-14.

Letter* from the Director of Agriculture, No. A.—10839, dated 1st December 1914.

RESOLUTION.—The general statement given by Mr. Keatinge of the changes that have taken place since he first took charge affords striking evidence of the expansion of the activities of the Agricultural Department during the last eight years. The budget grant has grown from just under 1½ lakhs in 1905-06 to nearly nine lakhs in the year under review. The grants for education demonstration and the introduction of improved methods of cultivation and up-to-date implements and machinery have steadily risen. The staff of the Department which in 1905-06 consisted of a Director, much of whose time was taken up with other duties, and one Deputy Director, with a scanty staff of low paid subordinates, now includes, besides a whole-time Director, a Principal, two Professors and five Assistant Professors attached to the Agricultural College, one Agricultural Engineer, three Deputy Directors, one extra Deputy Director, four Divisional Inspectors, sixty-four agricultural graduates and fifty-eight non-graduate fieldmen. During the same period the Agricultural College at Poona has been built, three vernacular agricultural schools, one in the Poona and one in the Dhárwár district and one in Sind, have been opened and the Department has now twenty agricultural stations and nineteen sub-stations for experimental purposes, while for demonstration work a graduate fieldman working under the Divisional Inspector has been provided for nearly every district.

2. Government entirely agree with the view taken by the Director that the energies of the Department should be directed mainly towards the improvement of methods of cultivation and that the introduction of foreign varieties of seed should take a secondary place. The success obtained with foreign varieties of groundnut has doubtless been a boon to many a poor man both in the Deccan and in the Konkan, but it is insignificant when compared with what might be effected if more energy were devoted by the ordinary ryot to cleaning his land and larger areas were brought to a proper state of cultivation. The difficulties that lie in the way are no doubt considerable in the Bombay Presidency with its numerous small holdings, and it is perhaps hardly surprising that the graduate fieldmen upon whom the task of tackling the problem more directly falls are apt to have their initiative blunted, but the present report affords evidence that the ryots are responding to the stimulus. This is clearly indicated by the continued demand for iron ploughs, by the success of the steam plough which was in operation in the Dhárwár District and by the interest taken in the College Farm which was visited by no less than 2,550 cultivators from all over the Deccan and last but not least by the entry into the field of co-operative societies. It is of good augury and a happy result of the close connection maintained between the Department and the co-operative movement, that besides societies organised for such purposes as co-operative dairying, cattle breeding and seed supply, the purely credit societies have begun to take an active part in improving the agricultural practice of their members.

3. As regards the introduction of improved varieties of seed, the Director in his report discusses the question chiefly with regard to the cotton crop which is of great importance in this Presidency. The conclusion he arrives at is that new varieties do not appeal to the cultivator unless they give an obvious improvement in quantity rather than in quality without adding appreciably to the labour and risk involved in cultivation. Cambodia cotton in the Dhárwár District fulfills these conditions sufficiently to justify expectations of an increased demand for the seed. They are present in a more marked degree in the case of Roseum (N R) cotton, for the introduction of which in Khándesh and the neighbouring

* Not printed.

districts a large seed farm was organised last year, and the demand for the seed is expanding with great rapidity. There is less certainty about the prospects of good stapled American cotton in Sind, but the position is so hopeful that the Department provided during the year the requisite seed farm and already the new variety has attracted the attention of the more enterprising of the zamindárs. In the case of other varieties which give better quality rather than greater quantity, for want of a market sufficiently sensitive to the improvement, expansion does not take place beyond the limited areas within which production and marketing can be supervised by the department.

4. During the year the department carried out a full and varied programme of research and experimental work. This is described in the appendices to the report and does not call for detailed comment in this review. One experiment however may be singled out for mention in view of the possibilities which it suggests. The sugarcane growers freely use power-pressed castor cake as a manure, but have a prejudice against power-pressed safflower cake, preferring the *ghání*-pressed article. At the Mánjri farm it has been demonstrated that the power-pressed cake is equal, if not superior, to the other. In his recently published monograph on the oil-pressing industry of the Presidency, Mr. Pandit brought to notice that a similar prejudice exists with regard to the use of power-pressed cotton cake as a fodder and pointed out that it had been demonstrated on the agricultural farms that to feed cows with cotton seed was an economic waste and that by substituting cotton cake for cotton seed the ryot would increase the milk-giving capacity of his animals and also obtain a better manure for his fields. The ignorance prevailing on the point has a prejudicial effect on the nascent oil pressing industry, on the success of which depends the important question whether the enormous drain out of the country of nitrogenous products in the shape of oil seeds and oil cake can be diminished.

5. The department also dealt with questions of a general nature such as the proper allotment and effective use of canal water, a subject of vital importance in the Presidency proper where irrigation depends almost entirely on costly storage reservoirs that are replenished only during the monsoon. This investigation was directed chiefly to the selection of lands for sugarcane and is to be followed up by a campaign against the wasteful and ineffective methods of cane cultivation at present in vogue. If the water and manure which are now wasted by over-irrigation were properly applied and if, instead of each grower crushing his cane with his own slow and inefficient bullock mill, operations were concentrated at convenient power crushing centres, a great advance would be made towards increased production at appreciably reduced cost.

6. No branch of the department has obtained more rapid and obvious results than the recently organised engineering branch which has enabled the cultivator to take advantage of the improvement in small power machines and irrigation pumps. The "mot" no longer holds the field as the cheapest means of raising water. It still has the advantage that it is easily made and repaired, but with the Agricultural Engineer and his staff at hand to aid him in designing and erecting an engine and pump and to teach him how to manage them, the cultivator can now invest with confidence in a plant that does the work more cheaply than a "mot", irrigates a larger area and sets free his bullocks for other uses. With regard to the boring experiments undertaken by the engineering branch, the Director of Agriculture is able to state the definite results of the operations carried on during the last five years in the alluvial soils of Gujarát. These are that an addition of 900,000 gallons per hour has been made to the irrigational resources of the country and that large tracts have been marked out where the finding of subsoil water under pressure can be guaranteed with fair certainty.

7. Turning to the educational side of the department's activities, the general progress at the Agricultural College during the year was satisfactory. In reviewing the report for the previous year Government commented on the decrease in the number of students who graduated in that year as compared with the figures for 1909 and 1910. The Principal has now explained why the numbers were high in 1909 and 1910 and low in 1913 and has recorded his opinion that from 25 to 30 may be regarded as the normal number of students appearing for the final examination. Presumably this includes those appearing for the College diploma as well as candidates for the Degree of Agriculture. If so, the figure for the year under review, which is 26, is normal. On the other hand, the Director in paragraph 25 of his report indicates that the College is not meeting all the demands from the public for trained agriculturists to manage

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estates. An encouraging feature is the growing popularity of the short course for the sons of farmers and land-owners, which is essentially a practical one for the benefit of persons who intend to take up actual agriculture. The number attending this course has risen from 12 in 1910-11 to 22 in the year under review.

8. The agricultural school at Loni was an experiment which was embarked on with some hesitation, but if developed on the lines indicated in the Report such schools are undoubtedly a good investment. A flow of boys carrying back to their villages the good manual training, the broadened outlook and appreciation of the possibilities of agricultural progress which they have acquired at school cannot but have a vivifying influence in the future. A similar school has been provided for Sind and another for the Southern Marátha Country, but further progress with the Department's programme, which includes an agricultural school at Godhra and one at Jambul in the Thána District, has been temporarily interfered with by the necessity of retrenchment which is at present unavoidable. The Governor in Council desires to express his appreciation of the public spirit shown by the people of the Chopda Táluka in providing by private subscription funds for the establishment of an agricultural school there, and is much gratified to hear of the good work that is being done at the school at Alibág which Sardár P. K. Bivalkar provided and maintains at his own expense.

9. The thanks of Government are due to Mr. Keatinge for the able manner in which he has administered the Department and the enthusiasm he has inspired in every branch of its activities and to the officers working under him for the excellent work they have done during the year.

C. W. A. TURNER,
Under Secretary to Government.

To

The Commissioner in Sind,
The Commissioner, N. D.,
The Commissioner, C. D.,
The Commissioner, S. D.,
The Commissioner of Customs, Salt, Opium and A'bkári,
All Collectors, including the Collectors in Sind and the Deputy Commissioner, Upper Sind Frontier,
The Director of Agriculture and of Co-operative Societies,
The Settlement Commissioner and Director of Land Records,
The Registrar of Co-operative Societies,
The Conservator of Forests, N. C.,
The Conservator of Forests, C. C.,
The Conservator of Forests, S. C.,
The Deputy Conservator of Forests in charge Sind Circle,
The Director of Public Instruction,
The Principal, Agricultural College, Poona,
The Superintendent of Land Records and Registration in Sind,
The Accountant General,
The Educational Department of the Secretariat,
The Political Department of the Secretariat,
The General Department of the Secretariat,
The Public Works Department of the Secretariat,
The Financial Department of the Secretariat,
The Non-official Members of the Legislative Council,
} With copies of the Report.

The Government of India,
The Under Secretary of State for India.
} By letter.